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THE

HISTORY

OF THE

ABSORBENT SYSTEM,

PART THE FIRST.

CONTAINING THE

CHYLOGRAPHY,

OR

DESCRIPTION

OF THE

HUMAN LACTEAL VESSELS,

WITH

THE DIFFERENT METHODS

OF DISCOVERING, INJECTING, AND PREPARING THEM,

AND THE

INSTRUMENTS USED FOR THESE PURPOSES.

ILLUSTRATED BY FIGURES,

BY JOHN SHELDON, SURGEON, F. R. S.

PROFESSOR OF ANATOMY IN THE ROYAL ACADEMY OF ARTS,
AND LECTURER OF ANATOMY, PHYSIOLOGY AND SURGERY.

LONDON,

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And may be had at his House in GREAT QUEEN-STREET, LINCOLN'S-INN-FIELDS.

MDCCLXXXIV.

TO

SIR JOSEPH BANKS, Bart.

PRESIDENT OF THE ROYAL SOCIETY,

&c. &c.

SIR,

THE following Work is publiſhed, in order to throw ſome light upon a very material, and hitherto almoſt unexplored part of the Structure of the Human Body,—the Lacteal Veſſels; by which freſh ſupplies are conveyed to the machine, and the waſte of the Animal is recruited.

This being a very important ſubject in Anatomy, which may with propriety be conſidered, as a branch of Natural Hiſtory, and the Work having already been honoured with your approbation, to whom could I more

more properly addreſs it, than to a Gentleman, who has not only cultivated this Science with great aſſiduity, but by whoſe patronage and munificence it hath alſo been ſo nobly encouraged?

Permit me therefore to requeſt your acceptance of theſe my firſt labours, as a ſmall token of gratitude for the ſeveral marks of friendſhip and favour which you have been pleaſed to confer on,

SIR,

Your much obliged

And devoted humble Servant,

Great Queen-Street,
March 20, 1784.

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INTRODUCTION.

AN accurate knowledge of the courſe, diſtribution, and terminations of the abſorbent, or lymphatic ſyſtem in the human body, cannot but prove of the utmoſt importance in the ſtudy of the animal œconomy, and in the practice of phyſic and ſurgery; ſince it will aſſiſt us in underſtanding many phænomena that ariſe in diſeaſes: while a ſimilar inveſtigation of the ſtructure of the coats of thoſe veſſels, and of the glands with which they communicate, will be equally beneficial in phyſiology and pathology. Every attempt therefore, that has hitherto been made to elucidate this new and difficult part of anatomy, when nature has been properly attended to in the deſcriptions and repreſentations, has ever been conſidered as a valuable addition to the ſcience.

The firſt diſcovery in this branch of anatomy, was accidental; but the accurate knowledge of the ſyſtem, is the reſult of much labour; for great anatomical dexterity is required to diſcover, inject and diſſect thoſe veſſels, becauſe it is extremely difficult to find them.

This difficulty ariſes from ſeveral circumſtances:

1. They are in general void of contents in the dead human ſubject.

2. Their coats are ſo pellucid, that it requires the moſt acute ſight of an anatomiſt, much accuſtomed to the appearance of the different ſyſtems of veſſels, to diſcern and diſtinguiſh them from veins or nerves.

3. There is alſo much difficulty in opening them in ſuch a manner as to be able to introduce proper inſtruments for injecting them, which in general, (except in the trunk, or thoracic duct) can ſeldom be effected with any other fluid but quickſilver. The difficulty of injecting even with this ſubtile fluid is increaſed, from the minuteneſs of theſe veſſels in many parts, and from their being crouded with numerous valves, which render it impoſſible to inject them any otherwiſe, than from branch to trunk.

4. Great caution and patience are requiſite to diſſect and prepare the

 lymphatics,

lymphatics, either for immediate demonſtration or future preſervation; and the difficulty of diſſection is increaſed, from the neceſſity of injecting with quickſilver: for if we happen to wound the veſſels, our labour will be loſt by the eſcape of that ſubtile fluid.

We ſhall ſtill have leſs occaſion to be ſurpriſed that the ancient anatomiſts have not diſcovered more of the lymphatic ſyſtem, when to the above-mentioned difficulties we add, that they were not ſo well acquainted with the art of injecting as the moderns. It is owen to the great improvement this art has received of late years, to the invention of new and better inſtruments for ſuch purpoſes, and to the greater frequency of diſſections, that we have attained our preſent knowledge of that ſyſtem.

The firſt diſcovery made on this ſubject in 1622, by Caſpar Aſellius, of the lacteal veſſels, gave the world but very imperfect ideas of this ſyſtem; as the anatomiſts of that period knew nothing but the lacteals, which they could eaſily obſerve and trace on the meſentery of many animals, where that membrane is tranſparent, either from there being no fat upon it, or from the fat being placed in the courſe of the larger trunks of the blood veſſels, as in kids, dogs, cats, horſes, aſſes, and moſt quadrupeds; but as they had not diſcovered the thoracic duct or trunk of this ſyſtem, and were unacquainted with the lymphatic veſſels, their knowledge of courſe muſt have been very imperfect, and particularly as Aſellius ſuppoſed that the lacteals paſſed on to the liver, which was conſidered by them as the hæmatopoetic viſcus.

Theſe veſſels were ſeen by many anatomiſts before the time of Aſellius, and accordingly we find mention made of white veſſels, (undoubtedly the lacteals) by Herophilus and Eraſiſtratus, but as they were unacquainted with the uſe of them, that of abſorbing the chyle from the cavity of the inteſtines, which circumſtance was proved by Aſellius; the diſcovery of them ought in juſtice to be attributed to him.

Soon after this, when the diſſection of living animals became very common among anatomiſts, Rudbeck, Bartholine, and Jolyffe diſcovered the lymphatic veſſels; and about the ſame time, Pecquet the thoracic duct, which laſt had been ſeen before, by Euſtachius, in a horſe.

We owe much to thoſe obſervers, for their diſcoveries and remarks upon this intereſting part of anatomy; and the names of Aſellius, Rudbeck,

Bartholine,

Bartholine, and many others, will be celebrated to the lateſt poſterity: we are likewiſe much indebted to Nuck, for a curious and original treatiſe on the abſorbent veſſels; and particularly to Ruyſch, Bidloo, and Riolan, for additional obſervations on this ſubject; but above all, to Pecquet, for his diſcovery of the thoracic duct, or trunk of this ſyſtem; as alſo to Van Horne, and many others. But I ſhall proceed to the hiſtory of the modern diſcoveries, ſince the honour due to the memory of thoſe anatomiſts, has been amply paid by the late illuſtrious Haller (*a*), by Mr. Hewſon (*b*), and by M. Portal (*c*).

It ſtill remained doubtful, whether the lymphatic ſyſtem were univerſally extended over the human body, for neither veſſels nor glands could be diſcovered in many parts, although great pains were taken for this purpoſe by different anatomiſts. Neither could any part of the abſorbent ſyſtem be diſcovered in birds, amphibious animals, and fiſhes, which claſſes make ſo conſiderable a portion of the animal creation, notwithſtanding the repeated reſearches of ſkilful practical anatomiſts. The moſt able phyſiologiſts were therefore of opinion, that as abſorption appeared to be carried on by the veins in thoſe animals, ſo theſe veſſels might perhaps perform the ſame office, in many parts of the human body.

The diſcovery of the abſorbent ſyſtem in birds, amphibious animals and fiſhes, was reſerved for two indefatigable Engliſh anatomiſts of the preſent age, Mr. John Hunter, and the late Mr. William Hewſon.

The former had obſerved the lacteals full of white chyle in the crocodile, an amphibious animal of the lizard tribe; and had likewiſe diſcovered lymphatic veſſels and lymphatic glands upon the necks of birds (*d*), particularly upon the neck of the ſwan, a conſiderable time before Mr. Hewſon's diſcovery of the whole of the abſorbent ſyſtem in thoſe animals. The latter, Mr. William Hewſon, by innumerable laborious diſſections, inſtituted on living and dead animals, diſcovered and injected the whole of the abſorbent ſyſtem in birds, amphibia, and fiſhes. By theſe important

(*a*) Vide Halleri Elementa Phyſiologiæ. Tom. vii. p. 201.
(*b*) See Hewſon's Experimental Inquiries, Part II.
(*c*) Portal Hiſtoire de L'Anatomie & de la Chirurgie, Tom. vi. p. 288.
(*d*) See Mr. Hewſon's experimental Inquiries into the Lymphatic Syſtem, p. 68.

diſcoveries

diſcoveries he proved the univerſality of the ſyſtem of abſorbents (*e*), and by demonſtrating their exiſtence in the above-mentioned animals, rendered it moſt probable that the veins, even in them, do not abſorb; ſince they are provided, as well as man and quadrupeds, with a peculiar ſyſtem for that purpoſe.

Some material experiments were made before this period by Mr. John Hunter (*f*), to determine whether the veins of the inteſtines performed he office of abſorption, as the generality of anatomiſts ſuppoſed. He injected ſolutions of muſk, and mixtures of indigo and ſtarch water, into the inteſtinal canals of various living animals, and opening the veins on the meſentery, he examined their contents, when the injected fluids could not be diſcovered in the blood taken from the meſenteric veins. Both the fluids, however, appeared upon opening the lacteals.

Since then the veins do not appear to perform the office of abſorption in the inteſtinal canal, we have much reaſon to conclude, from analogy, that they do not perform this office in other parts of the body: for the lacteals and lymphatic veſſels are exactly ſimilar in their ſtructure. Among former anatomiſts, we find ſome veſtiges of the abſorbent ſyſtem in birds, amphibious animals, and fiſhes, which merit our attention; but they chiefly relate to the lacteals (*g*).

It ſtill remains for ſome practical anatomiſt, converſant in injecting and preparing theſe veſſels, to give an accurate hiſtory of the abſorbents of every part of the human body, where they have been hitherto diſcovered. If we take the pains to ſearch for, and examine, all the figures and deſcriptions that have been publiſhed on this part of anatomy, before the preſent time, we ſhall find that the plates are few in number, very imperfect, and not in the leaſt reſembling nature; that they are chiefly taken from the brute creation, copied from one another, or that they are the offsprings of a fertile imagination. We have had ſome good obſervations, however,

(*e*) Theſe diſcoveries of our immortal Hewſon, were conſidered as ſo important in anatomy and phyſiology, that they were rewarded, by the Royal Society of London, with Sir John Copley's annual gold medal.

(*f*) See Medical Commentaries, by Dr. William Hunter, Part I. Ch. V. P. 42.

(*g*) Vide Halleri Elem. Phyſiologiæ, Tom. VII. P. 298.

from

from Nuck (*h*), Ruyſch (*i*), Duvernoi (*k*), Lieberkühn (*l*), and of late years from the preſent profeſſor Monro (*m*), Dr. Meckel (*n*), and Dr. Hunter, (*o*): but the laſt and moſt complete work of this kind, is that by the late moſt accurate Mr. William Hewſon (*p*), illuſtrated by figures of the lymphatic veſſels of the extremities, and of the trunk. In this work, however, though ſo lately publiſhed, we have no repreſentations of the lacteals, nor of the lymphatics of the different viſcera of the thorax, or abdomen; the lymphatic veſſels of the viſcera, and the lacteals in the human ſubject being very imperfectly known even at the late period of Mr. Hewſon's treatiſe.

To ſupply this deficiency, the following work is deſigned; in which I ſhall endeavour to correct the errors already publiſhed on this ſubject, and ſhall give figures from nature, of thoſe parts of the ſyſtem in the human body, where they have been falſely deſcribed, and where they have been recently diſcovered.

It is therefore propoſed to publiſh plates, with a copious explanation of every part of the abſorbent ſyſtem, and to begin with the lacteals.

We ſhall then proceed to the lymphatic veſſels of each particular viſcus, where we have been able to diſcover them by injection or otherwiſe; and ſhall endeavour, not only to point out and delineate their courſe upon, and in the different viſcera, but likewiſe to deſcribe and illuſtrate as much as poſſible their terminations towards their common trunk, the thoracic duct, by plates engraved from drawings of the original ſize, and accurately copied from nature.

Laſtly, a view ſhall be given of the lymphatics, of the ſuperior and inferior extremities in their natural ſize; and, as a ſupplement to this work, a ſpecimen ſhall be added of the lacteal veſſels, in quadrupeds, birds, amphibious animals and fiſhes, in order to complete the whole of the anatomical hiſtory of this new and intereſting ſubject.

(*h*) Nuck, Adenographia.
(*i*) Theſaurus Anatomicus.
(*k*) Duvernoi Comm. Acad. Petropol. Tom. I. P. 269.
(*l*) Diſſertatio de Fabrica & Actione villorum Inteſtinorum tenuium Hominis.
(*m*) Theſis de Vaſ. Lymph. Valv.
(*n*) Epiſtola ad Hallerum.
(*o*) Medical Commentaries.
(*p*) Experimental Inquiries, Part II.

Prefixed to this my firſt eſſay on the abſorbent ſyſtem, there is alſo a chapter on the method of diſcovering, injecting, and preparing theſe veſſels, with a plate of the lymphatic injecting tube, which will prove uſeful to all who wiſh to proſecute theſe inquiries. This unreſerved diſcovery, I flatter myſelf, will induce other anatomiſts to publiſh with their works, whatever they know reſpecting anatomical purſuits, or inveſtigations; for the progreſs of the ſcience has undoubtedly been much impeded by the myſtery obſerved among anatomiſts, reſpecting the compoſition of their injections, and their method of diſſecting, injecting, and preparing the different parts: a myſtery which deſerves the ſevereſt cenſure, and is unworthy of the character of a philoſopher or a man.

OF THE

ABSORBENT SYSTEM.

CHAP. I.

The Method of diſcovering, injecting, diſſecting, and preparing the Abſorbent Veſſels.

IT is preſumed that this work cannot be more properly begun, than by a deſcription of the contrivances that are made uſe of, for injecting and preparing the ſyſtem of abſorbents, and of the inſtruments neceſſary for thoſe purpoſes. This information will encourage many practical anatomiſts to labour upon this new branch of the ſcience, and the accurate knowledge of the ſyſtem will ariſe in proportion to the number of perſons employed in tracing the veſſels, and inſtituting experiments on living as well as dead animals; ſo that I ſhall diſcloſe, without reſerve, whatever I am acquainted with on this head. That we may proceed in this point with ſome kind of order, it will be neceſſary to conſider, 1ſt, The proper place to conduct ſuch inquiries; 2dly, The inſtruments and injections requiſite; 3dly, The ſubjects proper for theſe purpoſes; 4thly, The method of managing the different parts preparatory to injection; 5thly, the mode of preparing them after injection; which laſt point naturally includes two circumſtances,

cumſtances, diſſection and preſervation; this will comprehend the whole of the anatomical encheireſis.

1ſt, With reſpect to the choice of the place; a clear ſteady light, from a northern aſpect is moſt preferable; for the glare of ſunſhine is unfavourable to the diſcovery of theſe veſſels; and as we proſecute anatomical inquiries chiefly in the winter ſeaſon, the forenoon, or from ten to two, is the moſt eligible time; becauſe, during the winter the light is more clear at that period. I am alſo convinced, from experience, that the light by paſſing through the glaſs of a window, is better for this purpoſe than in the open air, as the veſſels are more diſtinctly ſeen. The thinneſs of their coats renders them apt to dry in the open air, which in a great meaſure prevents the injecting proceſs. The anatomiſt will likewiſe find it neceſſary to incline the part in different directions to the light, more particularly if he be endeavouring to diſcover lymphatic veſſels upon a ſurface, as the lacteal trunks, immediately under the peritoneal coat of the inteſtines, or the lymphatics on the external ſuperficies of the liver, or other ſurfaces. Theſe will be diſtinguiſhed with ſome particular glances of light, and are imperceptible with others. Perſons who are uſed to microſcopical obſervations, are well aware of the neceſſity of attending to this in their inquiries. I have never derived the leaſt aſſiſtance from uſing magnifying glaſſes, in order to perceive the veſſels previous to injection; on the contrary, I am perſuaded that thoſe who attempt to find them through this medium, will not acquire that *viſus eruditus* which is obtained to a ſurpriſing degree, by thoſe who have been much experienced in injecting lymphatic veſſels. A lateral light, as that from a common window, is alſo preferable to a horizontal, or perhaps even an oblique ſky-light. A table of convenient height, which might be contrived with a ledge, ſo fixed to the table as to be water proof, would be uſeful for preventing the quickſilver, which is almoſt always neceſſary for injecting theſe veſſels, from being loſt. The ſurface of the table ſhould alſo be ſo inclined from the outſide to the center, that the mercury which falls upon it may run towards the middle; where a hole might be contrived with a ſtopper, to take out occaſionally, that the quickſilver might be collected from the table. The quantity of mercury that would be ſaved by this machine to an anatomiſt who works much, would ſoon pay for the expence of it; this table

will

will alſo hold water for the purpoſe of ſteeping membranous parts, which we frequently have to inject, which, from being expoſed to the air, become dry, and which it is often inconvenient and hazardous to move into water, when we are at work upon them: or if a ledge be fixed, as above deſcribed, to a common horizontal table, and a hole cut to adapt a receptacle, the mercury might eaſily be ſwept into the center: this hole may be made round or ſquare according to the fancy of the anatomiſt; it ſhould be conſtructed of ſuch materials as are not liable to warp or ſplit even in warm water. If the anatomiſt be not provided with ſuch a table, the parts ſhould be laid in a tray, or earthen diſh, that the quickſilver may be ſaved.

Of the Injections.

THE injections that are uſed for filling the lymphatic veſſels and their trunks, are mercury, and the ceraceous or coarſe injection, as it is called by anatomiſts; the former is always uſed in injecting the lymphatics and lacteals, as it is almoſt impoſſible to fill them with any other fluid in the dead body; the latter, or ceraceous, is generally employed to inject the thoracic duct; in ſome particular inſtances, where the lymphatic trunks have been found larger than the ordinary ſize, a coarſe injection has been uſed (*a*).

In experiments on living animals, other materials can be made uſe of with great convenience and advantage, by injecting ſuch fluids into the cavities of the alimentary canal, as will be readily abſorbed; for inſtance, the feeding of dogs and other animals with milk, previous to the ſtrangling of them, the opening of the animal and perforating the ſmall inteſtines, and throwing in ſtarch water, with ſolutions of muſk, or mixtures of indigo and ſtarch water, as practiſed by Mr. Hunter (*b*), have greatly contributed towards making diſcoveries upon this ſyſtem: in a word, any gelatinous fluids, rendered opaque with ſuch colours as will be abſorbed,

(*a*) The preſent profeſſor Monro has a preparation of the lymphatic veſſels of the thigh, filled with a coarſe injection, in a ſubject where he found them of a large ſize. I have likewiſe injected ſome of the human lacteal veſſels with a ceraceous compoſition.

(*b*) See Dr. Hunter's Medical Commentaries.

are extremely uſeful for experiments of this kind; for much more can be ſeen by examining the veſſels diſtended with a coloured fluid from natural abſorption, than by anatomical injection practiſed in the dead body, and theſe parts may be readily preſerved for future inſpection, as ſhall be taken notice of hereafter. If ſuch experiments had not been made, we ſhould ſtill have doubted whether the veins did not perform the office of abſorption. The firſt diſcovery of the ampullulæ by Lieberkühn aroſe from feeding ſcrophulous children, in whom the lacteal glands were obſtructed previous to their death, with milk; by which means not only the lacteal trunks became diſtended with chyle, but likewiſe the ampullulæ. The experiments ſucceeded much better in theſe ſubjects from the chyle being ſtopped in the veſſels by the obſtructed cells of the lacteal glands. Thus the firſt origin, and even the abſorbing mouths of the lacteals were diſcovered by that lynx-eyed anatomiſt (*c*); and the firſt diſcovery of the lacteals by Aſellius, was alſo made from the veſſels being diſtended with the chyle. Euſtachius ſaw the thoracic duct in a horſe, by obſerving it full of chyle; and our immortal and ever to be regretted Hewſon, traced the lacteal veſſels, lymphatics, and thoracic duct, in birds, by making ligatures on the root of the meſentery, and other parts, in living geeſe, which he had previouſly fed with barley. Mr. J. Hunter alſo traced the lacteals in the crocodile, from their being loaded with chyle. By ſuch modes of inveſtigation we may diſcover many parts of the abſorbent ſyſtem, which are perhaps at preſent concealed from us; and which we may never be able to diſcover by injections practiſed on the dead body, or by any other method.

The quickſilver uſed for injecting the abſorbent veſſels, ſhould be as pure as poſſible: it is frequently adulterated, by being mixed with lead: it ſhould be perfectly dry and free from all extraneous matter, which may frequently be ſkimmed from the ſurface of the mercury, by expoſing it in a ſaucer, or by paſſing it through chamois leather; if wet, it may be readily dried by wiping it in an open veſſel with lint, or linen. The coarſe injection is made of yellow reſin and pure mutton ſuet; the proportion, two-thirds of reſin to one third of ſuet. If it be required of a firmer conſiſtence, a ſmall quantity of pure wax may be added; if of a

(*c*) Vide Lieberkuhn Diſſerat. de Fabrica, &c.

ſofter

ſofter quality, the quantity of ſuet muſt be increaſed; for the colouring powder, king's yellow, or orpiment is generally made uſe of; other colours may be employed, as Pruſſian blue, flake white, verdigreaſe, or vermilion.

Of the Inſtruments.

THE inſtruments neceſſary for an anatomiſt, who is preparing to inject lymphatic veſſels, are, the lymphatic injecting tube and pipes, lancets, blow-pipes, knives, ſciſſars, forceps, needles and thread. With reſpect to the lymphatic tube and pipes, which are the moſt material inſtruments, I have thought it neceſſary to repreſent them by a plate; for the ſucceſs of the anatomiſt depends very much upon the perfection of this inſtrument. The old inſtrument for this purpoſe, where the pipe is fixed to a glaſs tube of two or three feet in length, is of no uſe; and this is one reaſon why practical anatomiſts, before the time of our Hewſon, have been able to inject ſo little of this ſyſtem; ſuch long tubes are utterly unmanageable by one perſon, and if two be employed nothing can be well done; the operator ſhould hold the inſtrument in his hand like a pencil or pen.

The inſtuments I uſe, which are as manageable in the hand, when loaded with mercury, as the pencil is, are repreſented in Plate VI. Theſe tubes are made either of glaſs or braſs; the advantage of glaſs is, that we can readily obſerve when the quickſilver deſcends in the tube. The diſadvantage is, that it is more eaſily broken than the braſs one; the braſs one is inconvenient from its opacity, and is liable to be amalgamated by the mercury; but this laſt diſadvantage can be obviated by waxing the inſide of the tube, which is effected by warming it, and introducing a ſmall piece of wax, and ſhaking it in the tube, ſo as to line the inſide of it.

The glaſs tube is repreſented in Tab. VI. Fig. 1. which, as well as the other inſtruments there delineated, is of the natural ſize; the ſuperior extremity of the tube is made like the upper part of a funnel, for the convenience of pouring in the quickſilver, the other end has a collar of ſteel *a*, cemented to the tube, in which is a female ſcrew *b*, to receive the ſteel pipe Fig 2, by means of a male ſcrew *c*; this pipe is ſcrewed to the collar that

that is fixed to the tube, by laying hold of the godronned edge *d* with the fingers: the ſcrews ſhould be well fitted to prevent the mercury from eſcaping; and both the collar and pipe muſt be made of iron or ſteel, as braſs and every other metal is liable to be amalgamated by the quickſilver; the ſcrews ſhould likewiſe be kept well oiled to prevent them from ruſting. The pipe *e* is by far the moſt difficult part of the inſtrument for the workman to execute; it ſhould be drilled out of the ſolid metal, and not made of a flatted piece of iron beaten over a core or cylinder, and the ſides ſoldered together, as they ſometimes are by indifferent workmen. The laſt are ſubject to grow jagged at their extremities, are liable to cut the veſſels, and cannot be eaſily introduced; the ſolder is likewiſe apt to be amalgamated by the mercury, ſo that theſe pipes ſoon drop to pieces.

The pipes I uſe for injecting lymphatic veſſels, are made by drilling a hole through a piece of proper tempered wire (*d*). The pipe *e* muſt be accurately fixed in the bottom of the part *d*, which muſt have a hole ſo turned in it, as to correſpond above to the bottom of the tube, and below to the upper part of the ſteel pipe *e*; a piece of chamois leather, with a hole punched in it, muſt be put over the ſcrew ſo as to lie between the bottom of the collar *a*, and the part that applies to this bottom in the piece *d*: to prevent the mercury from paſſing out at this joint, it will be neceſſary that the anatomiſt ſhould be provided with ſeveral of theſe pipes, of different ſizes; they may be made, either with a godronned edge, for the purpoſe of taking hold of them to unſcrew them; or perhaps to greater advantage, with a ſquare piece, as at Fig 7, where *b* marks the ſquare piece into which the pipe is fixed, as before deſcribed; and upon which, to ſcrew or unſcrew, is uſed a plate of braſs or iron, Fig. 8, with a hole *a*, fitted to the part *b*; by which means the ſteel pipe can be ſhifted with greater facility. Fig 6, repreſents the braſs tube of the proper form and ſize, as made by the London workmen; *a*, a collar of the ſame metal, which is fixed to it, containing a female ſcrew as in the former deſcribed; the mouth of the tube might be made more capacious, as in the glaſs

(*d*) The beſt, and thoſe I have repreſented in the plate, were made by Mr. Evans, Surgeon's Inſtrument Maker, in the Old Change, near St. Paul's Church. They have been likewiſe as well made by Mr. Fike, Surgeon's Inſtrument Maker, in Ruſſel-Court, Drury-Lane, London.

through

one, with more advantage; or the mercury may be poured in through a ſmall funnel, made with a piece of paper, or card rolled together; or through a glaſs funnel. Fig 4. repreſents a very ſmall ſteel pipe, made ſimilar to that in Fig. 2; except that the pipe is curved, which I have found convenient to inject the lymphatic veſſels occurring upon ſurfaces, ſuch as very ſmall trunks and branches of lacteals, &c.

Fig. III. Repreſents a ſmall piece of iron wire poliſhed, which is to be kept bright and oiled; it is uſed to clean the pipe from the duſt that may lodge in, and obſtruct it, and is always to remain in the cavity, except when uſed; when paſſed into the pipe, it ſhould be carried from above downwards; it muſt be made of annealed wire, for if made of hard tempered wire, it will be liable to break in the cavity, and the workmen will have much difficulty in getting it out.

Fig. V. Repreſents a crooked iron wire, uſed for the curved pipe. It will be neceſſary that the anatomiſt have a proper caſe to lay theſe inſtruments in, for the conveniency of carrying them about. Smaller pipes than theſe may perhaps be required; and accordingly, I have ſometimes been obliged, though ſeldom, to uſe pipes of leſs dimenſions, which I have made by drawing out thin glaſs tubes into capillaries; theſe we can make as fine as we chuſe: they are indeed very apt to break, but are eaſily repaired with the flame of a lamp or candle, by the injector. Tubes of this kind (if the anatomiſt cannot make them) may be had of the artificers of thermometers and barometers, commonly called lamp-blowers: theſe tubes ſhould be thin, that they may readily melt with the fire; and they may be had at the glaſs-houſe. A ſteel ſtop-cock has ſometimes been fitted in the collar *a*, Fig. 1, with advantage.

2d. Lancets.—Exquiſitely ſharp ſpear-pointed lancets, are neceſſary to cut into the lymphatic veſſels; a blunt lancet, or any other inſtrument is improper for this purpoſe. 3d, Blow-pipes.—The ſmall ſilver blow-pipes, which are uſually put up in the diſſecting caſes, by the London Inſtrument Makers, are very well adapted for inflating the lymphatic veſſels; and theſe I have conſtantly uſed: diſſecting knives, fine pointed ſciſſars, accurately made diſſecting forceps, together with ſtraight or crooked needles, are requiſite. Steel blow-pipes may likewiſe be ſubſtituted with advantage, as they are not affected by the quickſilver.

The ſubject to be choſen for injecting any part of the abſorbent ſyſtem ſhould be as void of fat as poſſible: I have always found thoſe ſubjects who have died univerſally dropſical, or of an aſcites and anaſarca of long continuance, the beſt, for the following reaſons: in ſuch ſubjects there is little or no animal oil, and a very ſmall quantity of red blood; both which fluids, when they occur in great quantity in the body, obſcure and retard us in the diſcovery of theſe veſſels. When the cellular ſubſtance of the different parts is loaded with water, the abſorbents are more readily perceived, more diſtinct from each other, and of courſe traced with much greater eaſe, and leſs riſk of wounding them in diſſection; and the preparations, particularly the dried ones, are rendered more laſting. This is found to be of moſt conſequence in preparing the abſorbent veſſels of the extremities, and of the trunk, in the human ſubject; for the veſſels are diſtinguiſhed with greater difficulty in the extremities, than upon ſurfaces, as on the liver, inteſtines, &c.

The viſcera and extremities of any other ſubjects than adult ones, are very improper for diſſecting the abſorbent ſyſtem, except the liver and lungs, and theſe may be injected ſucceſsfully, even in the fœtus. If the anatomiſt be dexterous in diſtinguiſhing the veſſels, it is better to take the parts immediately after death, as he will be more likely to find lymph or chyle in the veſſels, and have the advantage of the parts being in a recent ſtate, and conſequently of a much greater length of time to purſue his object.

In living animals, the beſt method of diſcovering the lacteals (and that which is moſt commonly practiſed) is, to feed the animal with milk about two hours previous to the killing of him. As ſoon as the animal is ſtrangled, the root of the meſentery is to be tied; by which means, although the progreſs of the chyle will be ſtopped, the abſorption from the inteſtinal canal will take place for ſome time; I believe, as long as the muſcular irritability or periſtaltic motionof the inteſtines remain. The lacteals will of courſe be diſtended with the fluid; and as the chyle is prevented by the ligature from paſſing into the thoracic duct, they will become very turgid, and will be diſtinctly ſeen.

I have prepared the chyle in the veſſels ſo circumſtanced, by immediately plunging the inteſtines and meſentery (with the ligature upon the parts) into

into rectified ſpirit of wine. This proceſs will coagulate the chyle, and the fluid being opaque, the veſſels will be beautifully ſeen when we mean to prepare the parts by preſerving them in proof ſpirit as wet ſpecimens: in this way I have made in the dog one of the moſt natural preparations that can be ſeen, of the lacteals injected from their orifices by the natural abſorption. We may alſo prepare the lacteals by the ſame method as was uſed by Mr. Hunter, and which is deſcribed in the introduction to this work, page iv. They will then become very conſpicuous, from the indigo which will be abſorbed from the cavity of the inteſtines. We can bring to view and trace the abſorbents of moſt parts of the animal, by tying the thoracic duct near its inſertion into the angle formed between the jugular and ſubclavian vein on the left ſide; or by tying the jugular and ſubclavian veins on both ſides, we are capable of diſtending almoſt the whole of the abſorbents of the animal. By theſe precautions we are enabled to purſue theſe veſſels in many parts, where they have not before been diſcovered, where it is very difficult to trace them by injection, and even in ſome parts where it is utterly impoſſible for the injections to reach them.

I have been able to trace the abſorbents in ſome parts by another method, which I believe has been firſt practiſed by Malpighi, that is by putrefaction. If we ſteep the parts in water, and change the water as long as it is tinged by the blood being ſoaked out of the blood veſſels, ſuffering them afterwards to remain in the ſame water till putrefaction begins; the fixed air that is let looſe by this proceſs will get into the abſorbents, they will be eaſily ſeen, may be opened, and injected with quickſilver. It is remarkable that this method will not anſwer in general ſo well in the human ſubject as in quadrupeds; the fixed air can never be made to paſs by putrefaction into the human lacteals, at leaſt this event has never once happened in any inteſtines that I have macerated; yet it will take place in the lacteals of the horſe or aſs, and many other animals: and drawings of the lacteals can be made by this method to very great advantage. This proceſs may be ſucceſsfully adapted upon the liver, heart, and ſome other parts of the human body.

Ligatures may likewiſe be fixed on the large trunks of the veſſels, previous to the ſteeping of the parts in water, in order to confine the air that

is

is let looſe in the veſſels by the putrefaction, and to render them more turgid. If ligatures were applied to the wriſts, and to the legs immediately above the ancles of ſubjects *in articulo mortis*, or immediately after death, the lymph would be ſtopped in the lymphatic veſſels below the ligatures, they would become diſtended, and might be injected with the greateſt facility by the common method, previouſly taking off the ligature (*e*). It is of uſe in ſome inſtances, where we are ſearching after the lymphatic veſſels in the extremities, to make a ligature as before deſcribed, and for ſome time to ſtroke firmly the fingers and toes, and other parts, towards the ligature; by which means the ſmall quantity of lymph that remains in the lymphatic veſſels will be forced upwards, and arreſted by the ligature; the veſſels will then be ſeen by diſſection, and may be readily injected: all theſe circumſtances will be found of conſiderable uſe to the practical anatomiſt, upon different occaſions.

In order to inject the veſſels, it is neceſſary to open one or more of them according to the anatomical ſtructure of the part, directing the point of the lancet, in almoſt all caſes, towards the trunk, or trunks, of the veſſels; and taking care not to carry the inciſion through the oppoſite ſide of the coats. If the veſſels ſhould lie under the peritoneum, as the lacteals do, or under the pleura, as the lymphatics of the lungs, we may cut into the cavity of ſuch veſſels through theſe membranes. In injecting thoſe of the extremities, and in many other parts of the body, it is abſolutely neceſſary to diſſect the lymphatics we are about to fill, from the adjacent fat, and reticular ſubſtance, before we attempt to open them with the lancet. I have before obſerved, that the lancets uſed for cutting into the cavities of the abſorbents, muſt be exquiſitely ſharp; they are better, in my opinion, if ſpear-pointed: the opening made in the veſſel ſhould not be larger than is neceſſary to introduce the pipe. The tube, with the pipe affixed, is previouſly to be filled by the aſſiſtant, with dry pure quickſilver; the anatomiſt keeping his eye upon the puncture, takes the blow-pipe, and obſerves by inflating the puncture, whether the veſſel be

(*e*) The beſt method of making the ligature is by a tournequet. I have reaſon to believe that abſorption goes on as long as the muſcular irritability remains, which laſt continues for a conſiderable time after the general life of the animal is loſt.

opened;

opened; if he has ſucceeded, he takes the tube from the aſſiſtant, ſtill keeping his eye upon the puncture, and holding it juſt above the collar like a pen, he introduces it, by means of the puncture, into the cavity of the veſſel; taking care to carry it no further than is neceſſary to give the mercury a free paſſage. If he ſhould endeavour, as moſt beginners commonly do, to carry it far into the veſſel, by way of ſecurity, the end of the pipe will be puſhed againſt the ſide of the veſſel, and the quickſilver ſtopped. If the mercury ſhould not iſſue from between the outſide of the pipe, and the inſide of the coat of the veſſel, it will be unneceſſary to tie the pipe in the lymphatic. Care being taken to make the puncture ſmall, the pipe will fill up the orifice, and the tying of it ſhould be avoided if poſſible, becauſe the aſſiſtant, unleſs he be very dexterous, will frequently force out the pipe, in attempting to fix the ligature. If the quickſilver ſhould paſs on with freedom in the veſſels, we need only pour more of it into the tube as it deſcends; but if it be at a ſtand, we muſt preſs on the mercury in the veſſel with our fingers. This preſſure muſt be carried on higher and higher, in the courſe of the lymphatic, till we come near the gland, or glands, into which the veſſels terminate; otherwiſe we ſhall ſeldom get the cells of the glands, or the veſſels emerging from the oppoſite ſide of the gland well injected.

In injecting the lymphatic veſſels of the ſuperior and inferior extremities of the human body, it is uſeful to raiſe the part where the pipe is inſerted higher than the other end of the limb, and to make the aſſiſtant preſs with his hands along the ſkin, in the courſe of the veſſels, which will favour the progreſs of the injection. When the veſſels are ſufficiently filled, (which the anatomiſt determines by the turgeſcency of them, evident to the ſight and touch, and by the reſiſtance made upon the quickſilver in the tube,) the aſſiſtant paſſes a thread by means of a needle, if neceſſary, under the veſſel, and ties it above the puncture, before the anatomiſt withdraws the injecting pipe.

The method of injecting the larger trunks, or thoracic duct, with the ceraceous or coarſe injection, is exactly ſimilar to that of injecting the veins; and is ſo well known to all practical anatomiſts, that no deſcription of it is neceſſary in this work. I would recommend, however, the uſe of ſome pipes formed in a particular manner, which I contrived many years

ago, for paſſing into ſmall veſſels, eſpecially veins, as I have found them very convenient. This improvement conſiſts in ſhaping the ends of theſe pipes like the mouth of a pen, taking care to make the edges and point blunt, to avoid cutting the veſſel when we introduce them. The veſſels will admit much larger pipes of this form, than of the common ſort; neither is there any occaſion to make any bulb or riſing near the extremity of theſe ſmall pipes, to prevent the thread from ſlipping off, for this will certainly hinder us from inſerting pipes of ſo great a diameter, as we otherwiſe might. The coarſe injection being more liable to cool in paſſing through a ſmall, than through a large area: it is an invariable rule with anatomiſts to introduce pipes as large as poſſible, without running the riſk of lacerating the coats of the veſſels.

Let us now proceed to deſcribe the method of diſſecting, preparing, and preſerving the veſſels, ſo as to demonſtrate them immediately, or to preſerve them for demonſtration at any future period. Great caution and patience, as I have before obſerved, is abſolutely neceſſary, in purſuing the diſſection of theſe veſſels, to avoid the wounding of their coats, which are exquiſitely thin, and to prevent the mercury from eſcaping. If this accident ſhould happen, we muſt introduce the pipe at the ruptured part, and having ſecured it above and below by ligatures, we muſt fill the collapſed veſſels again.

The knives I would recommend for the diſſection of the lymphatic ſyſtem, are ſuch as are uſed by the French and German anatomiſts, in tracing the nerves. They muſt be made thin in the blade, like lancets, and not much larger. A variety of different ſhaped blades, ſome ſingle, others double edged, will be found uſeful for working on different parts; the common and chief fault of our diſſecting knives is, that they are much too thick in the blade, ſo that they ſoon get round on the edge, and require perpetual grinding: this is not the caſe with thoſe I have recommended. The forceps for theſe diſſections ſhould be ſharp pointed, that we may be able to lay faſt hold of the ſmalleſt portion of cellular ſubſtance with them; they ſhould not however be ſo ſharp as to endanger the puncturing of the veſſels; nor ſhould they by any means be bowed, but extremely eaſy in the ſpring, that they may not tire the fingers of the operator in working; and they ſhould be made ſo as to hold large, as well as ſmall portions of reticular ſubſtance. Fine pointed ſciſſars, and lancets

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in fixed handles, are ſometimes neceſſary for theſe diſſections. It is frequently of uſe to plunge the parts into water, in order to looſen the reticular membrane, connected with the outſide of the coats of the veſſels, by which means they will be diſſected with greater facility, and leſs riſk of wounding them. The blood, if any quantity ſhould remain, may be ſoaked out by changing the water repeatedly. The parts ſhould not be ſuffered to remain long in water, after being injected with quickſilver, becauſe the volatile alkali, which eſcapes from the part by putrefaction, is apt to decompoſe the mercury, to make it of a dark colour, and to change it into a black powder; by which means the preparation is ſpoiled.

After diſſection, the part is to be preſerved, either as a wet or dry preparation, according to its particular nature, or in ſome caſes, according to the fancy of the anatomiſt. Preparations of the larger maſſes, as the trunk and extremities, ſhould be preſerved dry, for which purpoſe they ſhould be placed in proper attitudes, expoſed to a current of air, but by no means to the rays of the ſun, and the veſſels ſhould be diſplayed in their natural ſituation. When the preparations are dry, both the veſſels and fleſhy parts ſhould be varniſhed over, either with good white ſpirit, or copal varniſh, to preſerve them from inſects, to render them more beautiful and laſting, and to make the veſſels more conſpicuous. They ſhould then be incloſed in glaſs caſes, handled as little as poſſible, and remain always in the horizontal ſituation. It will likewiſe be expedient for the anatomiſt to make drawings, of any thing remarkable or new in any preparation of the lymphatic veſſels with quickſilver; for moſt of theſe ſpecimens, particularly thoſe that are dried, ſuch as the extremities and trunk, become very much impaired, and totally deſtroyed by the veſſels growing indiſtinct, and at laſt inviſible, from the decompoſition of the mercury, by the eſcape of this fluid from the veſſels, or by the opacity of the varniſh with which they are covered.

Preparations of the thoracic duct are generally made by filling the veſſels with coarſe injection below the right crus, or little muſcle of the diaphragm; the aorta, ſuperior cava, and vena azygos, or intercoſtalis, being previouſly filled with a ſimilar injection. The duct is ſometimes prepared with quickſilver; this, although inconvenient for common preparations, becauſe the mercury is continually eſcaping from the veſſels;

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may ſtill be of uſe for particular purpoſes. Thus, for inſtance, if we wiſh to demonſtrate the valves in the thoracic duct, or any other large abſorbent veſſel, we need only inject the veſſels with quickſilver, diſſect and dry them, then cut them open, let the mercury run out, and the valves will be ſhewn by making ſections in the ſides of the coats of the veſſels. This may be done ſtill better, if the veſſel be varniſhed three or four times before the ſections are made, becauſe the varniſh will ſtrengthen the ſides of the veſſel. The valves in the cavities of theſe parts may likewiſe be demonſtrated in wet preparations, by opening them; or by inverting the veſſels and ſuſpending them in proof malt ſpirits. In this manner the valves that cover the terminations of the thoracic duct on the inſide of the angle, formed between the jugular and ſubclavian veins on the left ſide, and thoſe that guard the terminations of the lymphatics on the right ſide of the neck, right arm, and right lung, may be beautifully demonſtrated, if preſerved in ſpirits.

Specimens of the lacteal veſſels, of the abſorbents of the heart, lungs, liver, diaphragm, ſpleen, kidneys, and other viſcera, may be kept wet or dry, according to the particular nature of the preparation, or view of the anatomiſt. It is uſeful to dry ſome preparations, and afterwards to put them in glaſſes with oil of turpentine, by which means the fleſh will be rendered tranſparent, the veſſels will be diſtinctly ſeen, and the ſpecimens become exceeding beautiful. The chief diſadvantage of theſe preparations is, that the parts upon which the veſſels paſs, do not by any means preſerve their natural bulk or appearance, on account of their being dried: a diſadvantage which the wet preparations are exempt from; a circumſtance, which, in my opinion gives them a very great ſuperiority over the former, ſince they are of courſe more exact repreſentations of nature. It is frequently neceſſary to fix ſome preparations of the abſorbents that are to be preſerved in glaſſes, in ſpirits, or oil of turpentine, on paſteboard, or ſtiff paper of different colours, in order to ſupport them. They become ſo heavy from being loaded with mercury, that they cannot properly be ſuſpended, ſo as to be viewed, without this contrivance. The coloured paper is of uſe in forming a ground, or proper contraſt to the lymphatic and other injected veſſels. The ſmall preparations that are preſerved in ſpirits, or oil of turpentine, may be kept in bottles cloſed with well fitted ſtoppers;

ſtoppers; the larger in common preparation glaſſes. Some years ago I contrived a method of cloſing theſe preparation glaſſes, which I have uſed with great advantage; and by which I have preſerved an infinite number in my cabinet. The method is ſimple and eaſy to execute; and renders the preparations nearly as durable as the glaſs that contains them. In order to execute it, let the anatomiſt take care to have the upper ſurface of his bottles made plane, by deſiring the workmen at the glaſs-houſe to flatten them in the making. This they will eaſily do in forming the round ones, but in the making of flat bottles the circumſtance is attended with conſiderable difficulty. The right way to make theſe laſt, I believe, would be to blow them in moulds of various ſizes; the workman ſhould likewiſe form the bottoms of the bottles perfectly flat, in order that they may ſtand upright and ſteady.

Having provided ourſelves with bottles of this form, for our larger preparations, we grind the upper ſurface of them on a plane plate of lead, about the fourth of an inch in thickneſs, and two feet in diameter; firſt with fine emery and water, and afterwards with powdered rotten ſtone, or putty (*f*) firſt wet with water, and at laſt dry, ſo as to render the ſurface a horizontal plane, and of as fine a poliſh as plate glaſs; which will ſoon be done, as the manœuvre requires little dexterity. The anatomiſt ſhould be provided with a quantity of glaſſes prepared after this manner, to be ready upon all occaſions. To the top of each bottle a piece of plate glaſs, cut by a diamond, is to be adapted, ſo as completely to cover, but not project over, the edge of the bottle. When theſe two plane ſurfaces are placed on each other, and a drop of water put between; the attraction of coheſion is ſo conſiderable thar it requires great force to ſeparate them. Many preparations of the lymphatics, and other parts preſerved in bottles, do not require any ſtrings to ſuſpend them; particularly thoſe that are fixed on portions of paſteboard, or ſtiff paper; and ſuch as require ſuſpenſion ſhould be tied to ſtrings fixed to the preparation below, and to ſmall holes drilled in the ſubſtance of the glaſs at the bottom of the neck; or to ſmall bits of glaſs, that may be fixed on the inſide of the ſame part. The preparation is thus ſuſpended, if neceſſary, in limpid proof malt ſpirit; the bottle is to be almoſt completely filled with the ſpirit; the up-

(*f*) A preparation of tin ſo called.

per and poliſhed ſurface of the bottle, and the plate of glaſs, are to be wiped clean and dry; a drop of the ſolution of the ſolid gum arabic in water, is to be applied on the poliſhed ſurface of the bottle, the top is to be ſtrongly and ſteadily preſſed upon it, ſo as to bring the two ſurfaces in as cloſe contact as poſſible; and the bottle ſhould then be put in a cool airy place to dry. In two or three days after, we take a piece of the bladder of an ox or horſe, free from fat, and ſoaked ſo long in water as to become mucaginous. The water being well preſſed out, and the bladder carefully wiped with a dry coarſe cloth, it is then to be placed on the top of the cover of the bottle, and brought into cloſe contact with it, by carefully expreſſing all the air that may have inſinuated itſelf, between that and the inſide of the bladder. The bladder is next to be drawn tight over the neck of the bottle, and a piece of fine hard bound packthread, previouſly covered with the gum arabic ſolution, by means of a camel's hair pencil, is to be carried round the neck of the bottle, placing one turn of the ſtring cautiouſly below the other, ſo as to bind it equally ſtrong on every part of the neck. The ſtring is then to be tied firmly, the bladder is to be cut neatly off under the laſt turn of it, by a ſharpknife or lancet, and the bottle is again to be put to dry, with the above mentioned precautions. When it is perfectly dry, the ſtring is to be taken off cautiouſly, by cutting the knot, and beginning at the end that leads to the turn laſt applied. The top and neck of the bottle are then to be painted, with a compoſition made of lamp black, mixed with japanner's gold ſize: this ſoon dries and leaves a fine ſmooth gloſſy ſurface, from which the dirt can at any time be as readily wiped off, as from a mirror.

This method may appear to many anatomiſts complicated, and to require more time than the ordinary mode. But, on the other hand, it ſhould be conſidered that it renders the preparations extremely durable; and that the labour of grinding and poliſhing may be conſigned to a common ſervant, who will execute it with great expedition. In this way likewiſe, it is only neceſſary to tie the bottles once over; whereas in the common mode, practiſed in this country, we are obliged to tie them twice. Evaporation too, if the operation be well executed, is totally prevented by it: and the further trouble of opening the bottles, and renewing the ſpirits, as well as the expence of freſh ſpirits ſaved. All theſe circumſtances

ſtances taken together, I flatter myſelf that this will be looked upon as a very conſiderable improvement, ſince it certainly comes neareſt to the ſealing of bottles hermetically, which it is impoſſible to effect in common preparation bottles; nor would it anſwer for the ordinary purpoſes of practical anatomy, if even it could be done. Large bottles are as effectually ſecured by this contrivance as ſmall ones. Simple as the practice may appear, it has coſt me, however much application and expence, before I could bring it to that ſtate of perfection in which I now conſtantly uſe it, and with ſo much advantage. If the bottles do not ſtand ſteady, from the bottoms being uneven, we can eaſily grind them level with emery, on the above mentioned plate. I have diſcovered lately that if the tops be gummed, in the manner I have deſcribed, on the bottles, they will remain perfectly fixed without the bladder; although in the common upright bottles, it may be moſt adviſeable to put it on, as a defence to the top. Since I have found that the tops can be firmly ſecured without the bladder, I have uſed flat glaſs ſaucers, and have expoſed ſeveral preparations to great advantage in ſuch veſſels, in a horizontal ſituation. I have thus exhibited very early abortions in their membranes, and other preparations that cannot be conveniently ſuſpended or viewed in the perpendicular direction, by fixing covers of plate glaſs on them, as before deſcribed, without the bladder. Some very delicate preparations, particularly thoſe intended to be viewed with the microſcope, thoſe of the ampullulæ lacteæ Lieberkühnii, and thoſe of the valves of the abſorbents, may be preſerved either in ſpirits or dry, in ſuch tubes, to the greateſt advantage. Some of the dry ones too, may be placed in ſquare or oblong boxes, made of pieces of plate or common glaſs neatly gummed together, with narrow ſlips of white or coloured paper, and the objects may be viewed in this manner with convenience. In a word, many new contrivances in this way, will ſuggeſt themſelves to the ingenious practical anatomiſt. With reſpect to the ſtopper bottles, which are very convenient for keeping ſmall preparations, I would adviſe that the ſtoppers be perfectly well ground, that they paſs rather lower down than the neck of the bottle, for the convenience of drilling two ſmall holes, obliquely through the inferior edge of the ſubſtance of the ſtopper, oppoſite each other, for the paſſing of threads to fix the object; for if the threads paſs between the neck and the ſtopper, a

ſpace

ſpace will be left, or if the ſtopper be well ground, the neck of the bottle will be broken in endeavouring to preſs it down. On the other hand, if any ſpace be left, the thread will act from capillary attraction, raiſe the ſpirits from the bottle, and cauſe evaporation, which will likewiſe take place from the chink between the ſtopper and neck.

I have now finiſhed the whole of the anatomical encheireſis, and diſcovered, without reſerve, every circumſtance which may prove uſeful to thoſe, who wiſh to trace and prepare the abſorbent ſyſtem. The height of my ambition will be to increaſe the number of practical anatomiſts, and to raiſe a ſpirit of emulation among them, which may tend to the further progreſs of the ſcience, particularly in this important, and hitherto almoſt unexplored, track of anatomical knowledge.

CHAP.

CHAP. II.

CHYLOGRAPHY; or a Deſcription of the LACTEAL VESSELS.

On the Diſcovery of the Lacteal Veſſels, the Structure of their Coats, the Ampullulæ Lieberkühnii, and the Manner in which Nature produces Abſorption in the Lymphatic Syſtem.

ERaſiſtratus, who flouriſhed about 300 years before the Chriſtian æra, appears to be the firſt anatomiſt who ſaw the lacteals; he perceived them in diſſecting new-born kids, in whom they were diſtended with the opaque chyle, as in other ſucking animals; he found them paſſing the whole length of the meſentery, and thought they were arteries filled with the milk which the animal had taken for food. We have no reaſon to ſuppoſe, from the account Galen (*a*) has given on this ſubject, that he had the leaſt idea of their ſtructure or uſe. Herophilus (*b*), who was cotem-

(*a*) Γαληνε ει καλα φυσιν εν αρτηριαις αιμα περιεχηται, Βιβλιον. Editio Charteriana. Tomus tertius, p. 154.

(*b*) Γαληνε περι χρειας των εν ανθρωπε σωματι μοριων, λογος τεταρτος. Κεφαλαιον ιδ. Editio Charteriana. Tomus quartus, p. 392.

porary with Eraſiſtratus, likewiſe ſaw the lacteals in young animals, which he ſaid were deſtined to nouriſh the inteſtines: it was his opinion that they did not go to the vena portarum, like other veins, but that they tended to certain glandular bodies in the meſentery. Galen (*c*) alſo, who ſaw the lacteals in the kid, ſaid they were arteries: that they were full of the milk, and went to the glandular bodies at the upper part of the meſentery; that they did not go to the liver, and that they nouriſhed other parts beſide the inteſtines. In one place he thinks they are arteries, and in another, he is of opinion they are veins: he appears indeed to have known nothing more upon this ſubject, than what he borrowed from Herophilus, whoſe idea he adopts when he ſays they go to the glandular bodies in the meſentery. Upon the whole, it is evident that the ancients had no adequate notion of their diſtribution, anatomical ſtructure, or uſe.

We meet with no further account of the lacteal veſſels till the time of Aſellius. Some indeed have ſuppoſed that Euſtachius knew, and had repreſented them in his Plates; but Haller (*d*) is clearly of opinion that thoſe veſſels which have been taken for lacteals, in the plates of Euſtachius, are arteries and veins, in ſome meaſure concealed by the folds of the meſentery.

The diſcovery of theſe veſſels by Aſellius (*e*), as I have before obſerved in the introduction to this work, happened on the 23d of June, 1622, when at the deſire of many of his friends, he was going to make ſome experiments on the recurrent nerves and diaphragm, by opening a living dog, that had taken food a ſhort time before the diſſection. In order to diſcern the motion of the diaphragm, he opened the cavity of the abdomen; and obſerves, that in puſhing down the ſtomach and inteſtines towards the cavity of the pelvis, he perceived, upon the ſurface of the meſentery and inteſtines, great numbers of ſmall white threads, which at firſt ſight he took for nerves, but ſoon after diſcovered his error, by remarking that the nerves had a very different appearance; ſurpriſed at the novelty of the

(*c*) Locus ultimo citatus.

(*d*) Element. Phyſiol. Tom. vii. p. 201.

(*e*) Aſel. de Lactibus, ſeu lacteis venis, quarto meſaraicarum genere novo invento diſſertatio cum figuris elegantiſſimis. Mediolan. 1627. Baſileæ, 1621 in 4to. Ludg. Batav. 1640, 1641, in 8vo. 1645 in fol. cum oper. Spigelii.

fact,

fact, he ſuſpended his experiments, and paſſed over in ſilence the knowledge he had before obtained of the meſentery, and of its veſſels. To diſſipate his doubts, he opened one of the largeſt of theſe white cords. No ſooner had the inciſion been made, than he ſaw a fluid like milk, or cream, iſſue from the cavity of the veſſel. Aſellius ſays he could not contain his joy at the ſight of this phænomenon, and turning himſelf to Alexander Tadinus, and the ſenator Septalius, who were preſent, he invited them to enjoy this ſpectacle; but, "his pleaſure, he adds, was of ſhort duration, for the dog died and the veſſels diſappeared." The natural and ſimple manner in which Aſellius expreſſes himſelf, faithfully repreſents, as M. Portal obſerves, his aſtoniſhment, and gives an idea of the ſenſation which all anatomiſts experience at the inſtant of making any intereſting diſcovery. To confirm this fact, Aſellius ſoon after opened another dog, and his ſurpriſe was very great when he could not perceive the leaſt veſtige of theſe veſſels: he then opened a third, having previouſly fed him, and the chyliferous veſſels were again conſpicuous. Still there remained a doubt whether the lacteals exiſted in all animals; to be convinced of this, Aſellius bought thoſe he could procure: among others he informs us, that he purchaſed a horſe, which he opened ſoon after he had taken food, and found the lacteal veſſels.

Aſellius wiſhed much to ſee them in the human ſubject, but he was not raſh enough to open a living man. His words are, "Hominem vivum, "quod tamen Eraſiſtratus olim, et Herophilus non timuere, non incidi "(fateor,) nec incidam, qui nefas et piandum morte (cum Celſo) exiſtimo, "præſidem ſalutis humanæ artem, peſtem alicui, eamque atrociſſimam "inferre." (*f*)

When we diſcover new objects, continues Aſellius, we muſt give them ſome name, by which they may be characterized; the appellation of lacteal veſſels he thought was beſt ſuited to theſe.

Some cotemporary anatomiſts, jealous of his ſucceſs, have refuſed him the honour of this diſcovery; but upon the whole, he has few antagoniſts to combat, except Hoffman (*g*) and Harvey (*h*).

(*f*) Vide Aſel. de Lactibus. p. 30. Ludg. Batav. 1640.
(*g*) Apol. pro Gal. Lib. iii. Cap. 133.
(*h*) De Gen. Anim. p. 195.

Rolfinckius

Rolfinckius (*i*) demonſtrated theſe veſſels ſoon after Aſellius.

Aſellius tells us, that the ſtructure of the lacteals is ſimilar to that of the veins, that their external ſurface is ſmooth and poliſhed, and that the internal has ſeveral membranous productions, which perform the office of valves; he afterwards ſpeaks more clearly on this ſubject (*k*), "in his "illud admiratione dignum, quod pluribus valvulis ſive oſtiolis interſtincti "ſunt, ſive interciſi, quas ego valvulas &c. animadverti."

Theſe valves are found, according to Aſellius, not only at the origin of the lacteals from the inteſtines, but in many other parts throughout their courſe. He ſays the lacteal veſſels differ in their capacities, that they run more ſuperficially than other veſſels; and that they open from the cavities of the inteſtines, and principally from the jejunum.

Thus far the fortunate Aſellius deſcribes the veſſels with perſpicuity and accuracy; after which he deviates into error, and blends truth with falſhood, by adopting a miſtake of Andernac's (*l*), which Veſalius, Columbus, and ſeveral other anatomiſts had corrected. He places a gland in the middle of the meſentery, which he calls the pancreas. He ſays that this gland is ſituated like the veins, between the duplicature of the meſentery, that it is cellular, and that in theſe cells the veſſels run round like a labyrinth; large trunks of veſſels paſs on, which encirling the branches of the vena portarum, penetrate into the vena cava. Some of them, he ſays, open into the vena portarum; the greater number inſinuate themſelves into the liver, ramify as they penetrate into the ſubſtance of the gland, and become at laſt ſo ſmall and thin that they reſemble hairs. Theſe are the only remarkable circumſtances we find in the work of Aſellius. Had he known the thoracic duct, which was ſeen before him by Euſtachius, he would have traced the chyle and veſſels, not into the liver, but into the left ſubclavian vein.

Veſlingius (*m*) has deſcribed, and firſt given us a figure of the human lacteals; but it is evident, from the examination of his plate, that it is an imagined figure, and copied from Aſellius. The lacteals here repreſented, are very ſimilar to thoſe of a dog, the ſmall trunks which come from the

(*i*) Vide Elem. Phyſ. Tom. vii. p. 202.
(*k*) Aſel. de Lact. P. 52.
(*l*) Portal. Hiſt d'Anat. & Chir. Tom 1. p. 345.
(*m*) Veſling, Syntag. Anat. Tab. II. Fig. 1.

inteſtines

inteſtines paſs into larger ones on the meſentery of this animal. Inſtead of the lacteals being repreſented as directing their courſe to the numerous conglobate glands in the meſentery, (an invariable rule in the human ſubject) he carries them away to the human pancreas, ſhews them going into the inferior, and iſſuing from the ſuperior edge of that gland; after which they are delineated as forming four trunks nearly of the ſame ſize; each trunk is made to bifurcate, and to enter into the liver at the portæ.

Veſlingius has not repreſented in his figure, a ſingle lacteal gland on the meſentery; and the more we conſider this plate, the more we ſhall be convinced of its being an imagined figure. He has connected the lacteals with the pancreas, becauſe Aſellius had demonſtrated in his plate, and ſaid in his deſcriptions, that the lacteals went on to a large gland in the root of the meſentery, which he took for the pancreas of the animal. Aſellius too thought they went to the liver, therefore Veſlingius has connected his imagined lacteals with this gland. In his deſcription of the veſſels he ſays, "Quibus accenſendi ſunt meatus illi chylum deferentes, quod "ab ejus albicante colore tinctos *venas lacteas* appellat princeps eorum ob- "ſervator. Sed hi, quemadmodum à ſumpto cibo, aperto animantium ab- "domine evidenter in conſpectum veniunt, tranſparente per tenues tũnicas "nivei candoris ſucco; ita iiſdem vita defunctis, chylique diſtributione "ceſſante ſubtilium nervulorum, membranarumque ſpecie, ſenſum occu- "lorum fugiunt.

"Nec rarò tamen evenire ſolet, ut per intemperantiam hominum afflu- "ente per tot vaſa omnium humorum copiâ, impletis ſupra modum glan- "dulis, poriſque chylum deferentibus obſtructis, aut compreſſis, publica "coctio detrimenta plurima patiatur: aut colluvie corruptorum, putre- "ſcentiumque ſuccorum factâ, lentarum febrium & contumacium affectuum "aliorum, in meſenterio ſtabulum deprehendatur.

"Amplitudo ejus in obeſis ingens; adaucta largiter pinguedinis mole, "quæ frigidum, ſiccumque membranarum temperamentum, caloris ube- "rioris, ac humidi acceſſione lenit. Hærit circa ſupremam lumborum, ter- "tiamque vertebram, nexu admodum firmo. Extremis verò ſuis, inteſ- "tinorum volumina colligit, atque undique ſibi devincit.

"PANCREAS eſt pars abdominis glanduloſa, chylo ulteriùs, attenuando, "& depurgando, adeoque jecori, lenique preparando utiliſſima, antequam is

" nobiliore ſanguinis veluti purpura imbuatur. Quemadmodum enim ſan-
" guinem ipſum, qui fætui alimento futurus, aut pro generatione ejuſ-
" dem in ſemen tranſmutandus eſt, per varios quaſi gradus, ad perfectionem
" ſibi debitam natura deducit: ita quem in ſanguinem convertere conatur
" ſuccum, non in ore tantum alterat, in ventriculo concoquit, fæcum ad-
" miſtorum onere ſublevat; ſed in hoc viſcerum calidiorum veſtibulo, ex-
" actiùs quoque digerit, & ab acribus, ſalſiſque ſordibus vindicat. Itaque
" chylo, dum is ſpirante adhuc animali diſtribuitur, copiosè perfuſum eſt
" pancreas eundemque cuſpide cultri ſauciatum largiter effundit.

" Suſcipit chylum, ſuſceptumque jecori ſubminiſtrat, non per venas ullas,
" à porta deſcendentes, aut arterias; ſed ſingulares ductus, quos ob ſimi-
" litudinem aliquam, tum conformationis, tum diſtributionis, *venas* Aſellius
" nuncupavit, eaſque *lacteas*, ut ſuperiùs memini, quod candidum liquoris
" admiſſi colorem exprimant. Longa autem ſunt, & teretia vaſcula, ex
" membrana tenui producta, à pancreate ſurſum, circa deſcendentis venæ
" portæ truncum ad jecur; deorſum verò ad inteſtina, minutiſſimis propa-
" ginibus diſperſa. Valvulis prædita ſunt ſuſcepti liquoris ad inteſtina re-
" greſſum impedientibus. Ad lienem eadem pertingere, nexus pòtius
" pancreatis cum illo ſuadere potuit; quàm perſpecta hactenus meatuum
" manifeſtorum communio; quos & deliteſcere neceſſe eſt, cum aqueam
" chyli portionem, adeoque non coloratam lieni ſuppenditent.

" Origo venarum lactearum, haud aliunde rectiùs, quàm à pancreate du-
" citur. Arterias enim, venaſque rubentes, quibus illæ compoſitione of-
" ficioque cognatæ ſunt, non à ſurculis, ſed ampliore truncorum fundamento
" natura protendit. Idem in lacteis fieri vero ſimilius eſt, quarum funda-
" mentum, & amplitudo omnis circa pancreas; ramuli verò extremi in je-
" core, atque inteſtinis. Colligere eaſdem in communem aliquem truncum,
" ob latitudinem pancreatis inſignem, divino conditori non placuit; qui ſatis
" habuit, quemadmodum fit in nervis ad ſenſuum organa perducendis, illas
" à communi quadam ſcaturigine, ſed diſtinctis intervallis emittere."

It appears that Veſlingius knew nothing more than Aſellius had diſcovered in quadrupeds; but wiſhing to go beyond Aſellius, who had not been able to ſee the human lacteals, he produced this erroneous imaginary figure, by connecting the lacteals of a dog to the human pancreas and liver. It is a matter of extreme ſurpriſe, that this circumſtance has been overlooked

looked by the illuſtrious Haller, when he obſerves, that Veſſingius is the firſt who has given a figure of the human lacteal veſſels.

The exiſtence of the lacteal veſſels, diſcovered by Aſellius, was denied by the immortal Harvey, C. Hoffman, Riolan and others. Harvey (*n*) aſſerts, that the abſorption of the chyle is effected by the veins of the inteſtines. The lacteals were ſeen ſoon after by Rolfinckius, in 1626; by M. A. Severinus, in 1630; by Wormius, in 1630, or 1631; and by Hildanus, in 1632 (*o*).

During this century, the exiſtence of the lacteals appears to have been much doubted (*p*), until Pecquet (*q*) diſcovered the thoracic duct, by firſt obſerving a white opaque fluid, which he thought reſembled the chyle, upon opening the right ſide of the heart of a dog. From this accidental circumſtance, he was induced to trace the lacteals more particularly in theſe animals than Aſellius had done: he followed them into the receptaculum chyli, and diſcovered the thoracic duct, with the terminations of it, in the venous ſyſtem. This diſcovery was made, according to Haller (*r*), in the year 1649.

Veſſingius (*s*) is ſaid to have ſeen a large chyliferous veſſel, paſſing up the cavity of the cheſt; but it does not appear that he had any idea of its being the trunk of the ſyſtem: nor is the account he gives of it ſo clear as that by Euſtachius. About the ſame time Olaus Rudbeck (*t*) ſaw the duct, and traced it in the human ſubject, towards the year 1654; and in the ſame year Thomas Bartholin diſſected it in the human ſubject, as well as Diemerbroeck and Langius (*u*). Soon after the duct and lacteals were ſeen in the human ſpecies by a great number of anatomiſts, and in many quadrupeds, and even in ſome cetaceous animals.

About the year 1652, Dr. Jolyffe and Thomas Bartholin, diſcovered the remaining part of the ſyſtem. Thus, a complete and new ſyſtem of

(*n*) Vide Gener. Animal. p. 165.
(*o*) Elem. Phyſ. Tom. vii. p. 202.
(*p*) Ibid.
(*q*) Ibid. p. 203, 204.
(*r*) Ibid. p. 204.
(*s*) Ibid. p. 203.
(*t*) Ibid. p. 204.
(*u*) Ibid. p. 204.

veſſels,

veſſels, carrying fluids different from blood, was found to exiſt in the human body. For a more particular account of theſe diſcoveries, I refer the reader to the illuſtrious Haller (*w*), Hewſon (*x*), and Portal (*y*), where he will find ample information.

Let us now proceed to deſcribe the ſtructure of the membranes which compoſe the coats of the lacteals; which are exactly ſimilar to thoſe of the lymphatics. It has been ſuppoſed, on account of the tranſparency and tenuity of the coats of theſe veſſels, that it is impoſſible to determine their number and ſtructure. I flatter myſelf, however, that I can venture to ſpeak deciſively to thoſe two points. That there is a denſe internal coat, which is ſmooth and poliſhed on the inſide, is evident to all anatomiſts; it is connected by a reticular ſubſtance on its outſide, to the internal ſurface of the middle coat. This fine internal membrane prevents the tranſudation of the lymph and chyle, and produces certain duplicatures internally, which form the valves, found in every part of this ſyſtem; and it is exactly ſimilar to the internal coat of the veins. The ſecond coat, I apprehend, conſiſts chiefly of muſcular fibres running in every poſſible direction; the greater number take the circular direction, and ſurround the internal membrane. Theſe circular muſcular fibres I have ſeen in the thoracic duct of the horſe; in which animal the duct is as large as the little finger. We can alſo ſeparate an outer coat, which is made of a membrane ſimilar to the pleura, or peritoneum; after this we diſtinguiſh the fibrous middle coat, particularly the circular fibres, and under that the internal coat. The experiment will ſucceed beſt if the thoracic duct of this animal, or a large lacteal from the great inteſtines, be drawn over a glaſs tube, of ſuch a ſize as to require the veſſel to be ſomewhat dilated, in order that it may paſs over the tube. By this contrivance, I have ſeen the external coat ſlit in the longitudinal direction, while the veſſel was on the tube, and the middle muſcular coat, as well as the internal coat, have been thus diſ-

(*w*) Vide Hal. Element. Phyſ. Tom. i. p. 156.
(*x*) Hewſon's Experimental Inquiries, part ii. ch. i.
(*y*) Portal Hiſt. d'Anat. & Chir. Tom. vi. p. 288.

are

tinguiſhed (*z*). Hence ariſes the greater neceſſity for thoſe valves which are found in every part of this ſyſtem in the human ſubject, in the more perfect animals, as they are called by anatomiſts; and even in the turtle, among the claſs of amphibia.

The coats of theſe veſſels, in reſpect to number and ſtructure, appear to me to be analogous to thoſe of the arteries and veins. In theſe laſt I can diſtinguiſh in many animals, particularly in the turtle, the three coats I have deſcribed, by making a tranſverſe ſection of any large artery or vein near the heart of this animal, and even in ſome of theſe veſſels that are at a diſtance from the heart. In the ſpermatic arteries, in the gravid uterus of the cow, and in ſome arteries of the human body, I have for a long time exhibited ſuch ſpecimens in my anatomical courſes of lectures. I can likewiſe demonſtrate, that the external and internal coats of the veſſels are chiefly compoſed of the ſurrounding reticular ſubſtance compacted; and ſhall take this opportunity of obſerving, that the pleura and peritoneum are formed in the ſame manner. In ſome parts of the laſt mentioned membrane, I have long ſince exhibited in my lectures a fibrous appearance, evidently diſcernible by the naked eye. From a number of experiments indeed, which I have lately made in the human body, but particularly in the diſſection of large animals, ſuch as the horſe, aſs, &c. I am more ſtrongly convinced that Haller has great reaſon to aſſert, that the reticular membrane is the baſis, perhaps, of the whole of the fibres of animal bodies;—but a further diſcuſſion of this point at preſent, would be foreign to my purpoſe.

The coats of theſe veſſels are much ſtronger than thoſe of arteries and veins; this is evident from injecting them with quickſilver. They will ſuſtain a greater column of this fluid than arteries and veins of the ſame ſize, or perhaps four times as large, notwithſtanding their thinneſs and

(*z*) I have frequently expoſed large lymphatic veſſels in the necks of living dogs, in the courſe of the internal jugular veins, and having diſengaged them perfectly by diſſection, from all ſurrounding muſcles and veſſels, have preſſed them with my fingers to ſtop the progreſs of the lymph; upon which they have become ſwoln, turgid, and knotted at their valves: but upon removing my fingers, ſtill keeping the veſſel clear from the adjacent parts, to prevent any lateral preſſure, I have ſeen it contract ſo powerfully, that its cavity was completely cloſed.

tranſparency: a circumſtance, which, I apprehend, depends on their denſity. They are undoubtedly the moſt irritable of any ſyſtem of veſſels in animal bodies; this is evident from the exertion of their contractile powers, for they are generally found empty in the dead ſubject, and from experiments inſtituted on living bodies. There is a greater neceſſity for muſcular power in the abſorbent ſyſtem of veſſels, than in any other, becauſe they are not continued from the arteries as the veins are, and therefore appear to want the *vis a tergo*. Even in the ſilk-worm, and many other caterpillars, I have ſeen the lacteals loaded with white chyle, and have obſerved a knotted, or veſiculated appearance in them, which is the indication of the valves.

It is ſaid by the indefatigable Hewſon, that there are either no valves in the abſorbent veſſels of fiſhes, or that the valves give way to the injection, as it will paſs from trunk to branch in theſe animals. This I have conſtantly found by injecting their abſorbent ſyſtem, both in the flat fiſh, as the ſkate, and in the ſpinous, as the cod. It is probable that this difference may be owen to the circumſtance of their not breathing air, and not to their reſiding in water; as I find by diſſection, that the turtle, the whale claſs, and the ſeal kind, have valves in their lymphatic ſyſtem. All theſe animals are provided with lungs, and conſequently breathe air.

The valves of the abſorbent veſſels are made by duplicatures of the internal coat; they are of the creſcent form, exactly like thoſe in the veins, and are generally formed in pairs, except where a ſmall veſſel is inſerted into a larger; in which caſe there is no neceſſity for two. Nature therefore places a ſingle creſcent over the orifice: the openings of the abſorbent ſyſtem into the venous are guarded in the ſame manner, and the retrograde motion of the fluid is prevented.

The uſes of the valves in the abſorbent ſyſtem, ſo far as we have diſcovered, are to ſuſtain the weight of the column of fluid above the valve, and prevent the preſſure of it on the fluid below, to impede the retrograde motion of the lymph and chyle, and conſequently to forward its progreſſion towards the venous ſyſtem and heart; for as it is impoſſible that the chyle and lymph can paſs backwards, on account of their being reſiſted by the valves, it follows, that the muſcular power of the veſſel, aſſiſted by the collateral preſſure produced by reſpiration, and by the adjacent muſcles and arteries will impel the fluid towards the heart.

We

We ſhall next conſider the manner in which theſe veſſels firſt perform abſorption. I am inclined to think, from analogy, that this is effected by capillary attraction. In the human eye, for inſtance, we have a fluid ſecreted to waſh extraneous matter from the external ſurface of the cornea, and keep it clear for the purpoſe of viſion: the fluid, when it has performed this office, is taken up by the puncta lachrymalia, and carried into the noſe; theſe capillary tubes are kept conſtantly open to anſwer this purpoſe, thus affording us a moſt beautiful example of abſorption taking place from capillary attraction.

It has been diſcovered by Cotunnius (*a*), that the cavities of ſome of the internal parts of the ear, ſuch as the ſemicircular canals and cochlea, are filled with a fluid, which is ſecreted by the internal membrane or perioſteum; and that there are two capillary orifices, which he calls aquæ ductus veſtibuli, & cochleæ, to abſorb this fluid. According to the preſent profeſſor Meckel, theſe orifices convey the fluid, to the lymphatic veſſels, upon the dura mater; which afterwards communicate with the ſinuſſes of the ſame membrane: this appears to be effected by capillary attraction. In order to produce abſorption in the lymphatic ſyſtem, it is neceſſary that the orifices of the veſſels, during this action, ſhould be kept conſtantly open; this may be accompliſhed by a derivation of blood to the villi of the inteſtines. Thus the blood conveyed to the coats of the abſorbent veſſels, producing a ſpecies of erection in the villi of the inteſtines, may keep the orifices of the lacteal veſſels in the villi open; and as long as the derivation continues, the fluid will riſe in the veſſel by capillary attraction. When it has got into the veſſel, it cannot paſs back again, on account of the reſiſtance made by the valves; abſorption will therefore continue as long as the orifices are kept open, provided they be in contact with the fluid.

The ſolids of animal bodies are equally capable of being abſorbed, as the fluids. This circumſtance has been firſt aſſerted, and demonſtrated by Mr. John Hunter, and taught publicly in his lectures on ſurgery, for ſeveral years; particularly in his lectures on ulceration in general, exfoliation, and other diſeaſes of bone, &c.

(*a*) Vide Cotunnius de Aqueduct. Auris Humanæ.

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The thoracic duct was found full of calcareous earth, by Mr. Cheſton (*b*) of Glouceſter, in a man who had a ſpina ventoſa on the os ilium, ſo that the cavity of the duct was totally obſtructed, for a conſiderable length, with oſſific matter, and would not ſuffer air to paſs upon endeavouring to inflate it from the part below the obſtruction, to the part above. We have in this caſe an inſtance of calcareous matter being abſorbed, and found in the trunk of the lymphatic ſyſtem: from which ſome perſons have inconſiderately concluded, the man in this caſe being apparently well nouriſhed, that the lacteals, or thoracic duct, had other terminations in the venous ſyſtem, below the obſtructed part; there being no other way to account for the nutrition received in this inſtance, when the duct was obſtructed below the terminations at the angle between the jugular and ſubclavian vein. I am of opinion that the chyle and lymph, brought up by the thoracic duct, to the part immediately below the obſtruction, were conveyed by the collateral anaſtomoſing branches, to that portion of the duct above the obſtructed part. Theſe branches nature has given in greater plenty in the abſorbent ſyſtem, than in the arteries or veins; which I ſhall prove by direct experiments in the courſe of the work.

If an animal be fed with madder, it is well known that the earth of the bones will be ſtrongly dyed, of a red colour, by the madder; and, as far as we yet know, no other part of the animal, except the earth of the bone, will be affected. If a calculus be formed in the urinary bladder of the animal, when the bones are coloured by the madder, which can be produced by the introduction of any extraneous ſubſtance into that organ; the earth which compoſes the calculus will be of a red colour, ſimilar to that of the dyed bones. If we ſuſpend for a time the feeding of the animal with madder, and then feed him again on the ſame ſubſtance, and proceed alternately in this manner; upon cutting the ſtone through, either by a perpendicular, or horizontal ſection, ſtreaks of red will be found intermixed with others exhibiting the ordinary colour of the urinary calculus. This phænomenon cannot be otherwiſe explained than by ſuppoſing the earth of the bone to be abſorbed by the lymphatics, and by them con-

(*b*) See Phil. Tranſact. Vol. lxx. part. ii. p. 323.

veyed

veyed into the ſanguiferous ſyſtem; where being ſecreted by the emulgent arteries from the blood, with the earth of the urine, it is afterwards attracted by the nucleus introduced into the bladder. Some years ago, when from obſerving ſeveral phænomena in the human body, the idea firſt ſuggeſted itſelf to me, that the earth of the bone was continually changing, by the depoſition of new matter, and abſorption of the old; I had a converſation on this ſubject with Mr. J. Hunter, who informed me that he had fed himſelf with madder. I immediately aſked him, whether he had obſerved that the earth of his urine was tinged by the madder: to which he anſwered, that the earth attracted by the ſides of the veſſel, in which the urine was made, was of a red colour.

In the *mollities oſſium* likewiſe; a diſeaſe, the cauſe of which has not been well underſtood till of late: it is probable that the calcareous earth of the bone is abſorbed, and carried out of the body, by the action of the kidneys, in the ſecretion of the urine. It has been obſerved by the late Mr. Thompſon, of the London Hoſpital, in the caſe of James Stevenſon (*c*); "That his urine, for the two firſt years of his illneſs, generally depoſited "a whitiſh ſediment; which, upon evaporation, became like mortar, and "he voided three or four ſmall jagged ſtones ſometime after a complaint "in his loins." From this account we have every reaſon to believe, that the ſoftneſs and want of ſtability in the bones of this ſubject, were occaſioned by the abſorption of the calcareous earth, by the lymphatic veſſels in the bones. He was firſt taken ill in 1766, and in November 1768, two years after, his bones began to break under him; and the greater part of the calcareous earth being abſorbed, the ſolidity of the bones was deſtroyed. It is ſcarce poſſible to obtain a more evident proof of the abſorption of ſolids, by the lymphatic ſyſtem, than this. We cannot indeed have any adequate idea of the exfoliation, and of moſt of the diſeaſes of bones, of the formation of bone, or of the alteration in its appearance, which is continually taking place, from the earlieſt ſtate of infancy, till the completion of the adult age; nor can we form any conception of the growth of the teeth, and of the changes in the alveolar proceſſes of the jaws, particu-

(*c*) See Medical Obſervations and Inquiries, Vol. v. p. 266, and 267.

larly in the ſhedding of the teeth, the evaneſcence of the old ſockets, and the production of the new; or account for ulceration itſelf, unleſs we admit that the ſolids are capable of being abſorbed: for nature can as eaſily remove parts, as form them. In a word, there are many phænomena in animal bodies, which appear to be utterly inexplicable, without this circumſtance.

An opinion has been generally entertained, that the orifices of the lacteals, which open on the villoſe coat of the inteſtines, are too ſmall to be viewed by the beſt microſcopes: I am not ſurpriſed at this, when I conſider that their large branches, and even their trunks, are not to be ſeen, unleſs loaded with chyle, by anatomiſts themſelves; except they are very converſant with this ſyſtem. The firſt anatomiſt who has demonſtrated their origin, from the villoſe coat of the inteſtines, is Lieberkühn, one of the beſt microſcopic obſervers who ever exiſted; he has given a very ample deſcription of them, with a plate engraved by the famous Lionet, in that moſt ample and elaborate diſſertation, which he publiſhed in the year 1744. This work I have re-publiſhed with the Author's Life: the diſſertations it contains, which may be conſidered as maſter pieces in the ſcience, are little known, and exceeding ſcarce in this country.

In page 2, ſection ii, he ſays, " (*d*) Ad quemvis villum ex vaſis majoribus
" tunicæ vaſculoſæ procedit
" 1. Ramuſculus vaſis lactei valvulis munitus.
" 2. Rami arteriolarum.
" 3. Venula quædam.
" 4. Nervus.
" 1mo. Vidi in cadaveribus, lacte copioſo paulo ante mortem nutritis,
" vitioque pulmonum & infarctu glandularum meſentericarum extinctis,
" vaſa lactea caſeo repleta, & quidem longe majori copia, quam ipſa vaſa
" ſanguifera, quæ ſimul cera viridi & rubra impleveram: nec lactea hæc
" tantum in meſenterio vidi, quod ſæpius accidit, ſed in ipſa etiam tunica
" inteſtinorum vaſculoſa.

(*d*) Vide Joannis Lieberkuhn, de Fabrica & Actione, &c. p. 2, in Diſſertationibus quatuor à me editis Lond. 1782.

" Servo

" Servo adhuc in liquore partem meſenterii infantis proxime ad inteſtini
" tubum abſciſſam, in qua tria hæc vaſorum genera videre licet diſtinctiſſime.
" Villoſam nimirum cultro acutiſſimo a vaſculoſa exacte ſeparavi, portiun-
" culam deinde ejus, ſupra annulum metallicum extenſam, ea ſede, qua
" illi cohæſerat, microſcopio examinavi: nactus ſic opportunitatem exop-
" tatiſſimam videndi, ac diſcendi, ad ſingulum villum accedere ramum tan-
" tumnodo unum vaſis lactei, valvulis, æque ac vaſa lactea majora muni-
" tum, lacte turgentem & exinde propendentem.

" Ratio quare in ejuſmodi corporibus vaſa lactea diſtinctius, quam in aliis,
" videantur, facile patet, Quum enim glandulæ meſenterii obſtructæ ſerum
" non niſi ægre tranſmittant, & huic in pulmonibus quoque reſiſtentia ma-
" jor naſcatur, caſeoſo craſſamento infarcientur omnia vaſa lactea tunicæ
" vaſculoſæ ad prima eorum principia uſque. Moribundis aliquoties, ubi
" hæ conditiones aderant, lac copioſe potandum dedi, & fere ſemper ſuc-
" ceſſit experimentum.

" 2do. Ut plurimum ex ramo arterioſo & venoſo tunicæ vaſculoſæ, qui
" villo proximi erant, plures arteriolæ, at una tantum vena, materie ce-
" racea plena accedebant ad villum; aliquando tamen plures etiam venulas
" deprehendi.

" Raro autem contigit ut, in eodem villo, arterias intrantes in villum
" alio colore, alio autem venam, impletas conſpicerem; licet trecentis mi-
" nimum vicibus arteriam meſentericam alio colore tincta materie, alio
" autem venam impleviſſem: via enim ex arteriis in venam nimis brevis
" eſt, ita ut vel ex hac in illam, vel ex illa in hanc, materies facillime
" eat, redeatque.

" 4. Nervos ad villos accedere nemo negabit; nec eorum in his exiſtentia
" alia demonſtratione egere videtur, quam quæ ab acutiſſimo inteſtinorum
" ſenſu & dolore depromitur. In vaſculoſa demonſtrari adhuc quidem ner-
" vuli poſſunt, & microſcopiis filamenta quædam a vaſis diſtincta cernun-
" tur; ſed quomodo in villoſam migrent, & in hac terminentur, quis de-
" terminaverit?

" Ramuſculus vaſis lactei extenditur in ampullulam vel veſiculam ovulo
" haud abſimilem, in cujus apice foraminulum quoddam exiguum micro-
" ſcopio detegitur.

" Inveni villos in partibus quibuſdam inteſtinorum (memoratorum) lacte

" caſeoſo

" caſeoſo infarctos turgere. Vidi, ſeparata tunica vaſculoſa, in ſede vil-
" loſæ hanc reſpiciente, lacteum abire in ampullulam caſeo plenam. Si
" quis vero foraminulum in apice hujus ampullulæ invenire velit, ei ne-
" ceſſum eſt, ut portiunculam inteſtini, cujus villorum cava diſtenta ſunt
" lacte, & mucus inteſtinalis nondum deterſus, ſupra annulum metallicum
" parumper abſque vi facta expandat, tum immittat in lagenulam vitream
" aqua plenam, & microſcopio objiciat.

" Quod autem unum ſaltem adſit foraminulum in cujuſvis ampullulæ
" apice, certo examine mihi conſtat: interdum tamen, licet rariſſime, plura,
" ut in papillis mammarum, vidiſſe memini. Nec ratio latet, quare in lacte
" turgidis villis foraminula hæc tantum obſerventur. Scilicet dilatato villo
" orificia iſthæc exigua quoque dilitantur. Idem fit, ſi mucus intra villos
" relinquitur, & pars inteſtini ſupra annulum extenditur: quum enim hic
" mucus cum villis cohæreat, horum ſeparatio fieri nequit quin latera fo-
" raminulorum ab invicem diducantur.

" Supra hanc veſiculam rami arteriarum ad apicem ejus uſque decur-
" rentes, ſe dividunt in quam plurimos ramulos minores; ita ut dimidiam
" ejus ſuperficiem ſerpentinis vaſculis tegant.

" Hæc ſic ſe habere in preparatis nitidiſſimis microſcopii ope cuivis de-
" monſtrare poſſum. Abſcidi nempe portiunculam inteſtini, cujus villi op-
" time impleti erant, eamque immiſi in lagenulam vitream ex tubo ovali
" paratam & ſpritu vini diluto plenam, quam hermetice ſigillatam conſervo;
" ut dubitantem quemvis, ipſa autopſia, quandocunque libuerit, convincere
" valeam.

" (*e*) Nonnulli autem rami arteriarum & venularum deſcriptarum, trun-
" culis his ſuis longe minores, perforant bullulam lactei & in hanc apertis
" oſculis hiant.

" Impleo in arteriam meſentericam materiem ceraceam tenaciorem, ita
" ut redeat per venam meſentericam ſat magna quantitate. Examino dein
" microſcopio quam plurimos villos: invenio in omnibus non modo diſtenta
" vaſcula, ſed etiam turgere ampullulam lactei cera alba plenam. De-
" monſtro & hoc præparatis.

(*e*) Vide Differt. Lieberkuhn, ut antea, p. 9.

" (*f*) Uno

" (*f*) Uno tandem experimento, aſt quod irrito conatu ſæpius repe-
" tendum erit, ſi quis accuratius adhuc videre cupiat, ſequenti modo
" procedat. Sumat inteſtini partem parvam, ad quam notabilis ramus
" arteriæ & venæ accedit; hanc intercipiat intra annulos duos metal-
" licos, qui e lateribus connexi ad ſe invicem accedere conantur: ibi au-
" tem, ubi arteria ad hanc partem accedit, in uno annulorum crenulam
" faciat, ita ut arteria libera, nec compreſſa, ad hanc partem accedere
" queat: tunc huic arteriæ adliget tubulum exiguum, & huic canalem ali-
" quot pedes longum, quem in ſitu ab horizontali non multum abſcedente
" conſtitutum, materia non facile conſiſtente, bene colorata, impleat: ex-
" ponat dein partem inteſtini microſcopio, & attente obſervando villos,
" tubum ſucceſſive è ſitu horizontali ad perpendicularem dirigat: ſic videbit
" jucundo ſpectaculo,
" 1mo. Materiem intrare per arterias in villum.
" 2. Dare quam plurimos ramos ſerpentino modo decurrentes.
" 3. Ex his pergere ad totidem venulas.
" 4. Ex his ad venam ex villo exeuntem.
" 5. Tunc tandem per alia vaſcula minora intrare in ampullulam lactei diſt-
" endere hanc, & demum,
" 6. Exire per foramen in apice hujus patens.

" Ampullula vaſis lactei, hactenus deſcripta, intus repleta eſt ſubſtantia
" ſpongioſa.

" Infles per arteriam vel venam meſentericam, partem inteſtini intra
" duos annulos metallicos interceptam, aditu arteriæ vel venæ libero ma-
" nente, ut in experimento §. præcedentis; penetrabit aër per vaſa deſ-
" cripta in cavum villorum, diſtendet hos, & ex his per foraminula in apice
" bullularum exibit. Si ceſſas flando, collabuntur iterum villi; ſed ſi
" continuas, quod applicatione follis facile fit, donec exſiccaveris, diſtenti
" manebunt. Tunc cultro raſorio acutiſſimo finde villos, & videbis mi-
" croſcopio eorum cavum impletum eſſe materie quadam ſpongioſa vel cel-
" luloſa."

In this quotation from Lieberkühn, we have a moſt accurate deſcription of the minute anatomical ſtructure of the villi of the inteſtines, of the

(*f*) Vide Differt. Anat. Lieb. p. 11. §. II.

beginnings of the lacteal veſſels from the internal ſurface of the villoſe coat, and even of their orifices; and there is no doubt that this excellent microſcopic obſerver not only ſaw, but was likewiſe the firſt who diſcovered them. As he did not make the diſcovery by chance, he deſerves much praiſe for his ſagacity in previouſly preparing the veſſels, in living ſubjects, by giving them milk juſt before they expired, and for the great pains he took in making experiments, and injecting them after death.

It is a matter of ſurpriſe that greater attention has not been paid by anatomiſts to this diſcovery of Lieberkühn's, for I do not find that any of my cotemporaries, except one (*g*) have ſeen the ampullulæ. Mr. Hewſon (*h*) denies the exiſtence of them; he is of opinion that they are not found in birds, fiſhes, and amphibious animals; for theſe claſſes of animals have net-works of lacteals, as well as of arteries and veins, on the villi of their inteſtines: he therefore concludes it to be moſt probable that the lacteal veſſels have the ſame ſtructure in the human ſubject. He ſays, "he can clearly ſhew the orifices of the lacteals on the extremities of the villi, where there appear, (as Lieberkühn has deſcribed) ſometimes one, and ſometimes more orifices: that when the preparation was not injected to a great degree of minuteneſs, the villi appeared exactly as Lieberkühn had figured them, and when they were examined with the microſcope, no orifices could be obſerved, each of them appearing to have a ſmooth edge; in ſome part of the ileon, where the injection had run more minutely, the villi appeared erected; and inſtead of being broad and thin, were more round and cylindrical, and their extremities ſeemed ſpongy and porous, while the ſides of the villi were perfectly ſmooth and uniform." Mr. Hewſon thinks "as in theſe preparations the orifices only appeared when the villi were completely erected, that this circumſtance points out the uſe of the villi," he ſays "on repeatedly examining them, he obſerved the pores or orifices very diſtinct and empty."

The next anatomiſt who has deſcribed the ampullulæ, is the ingenious Mr. Cruikſhank. In his letter to Mr. Clare he ſays, that he found the

(*g*) Mr. Cruikſhank, Lecturer of Anatomy and Surgery, London. See Mr. Cruikſhank's letter to Mr. Clare, publiſhed in an Eſſay on the Cure of Abceſſes by Cauſtic, &c. &c. by Peter Clare, Surgeon, 2d. Edition in 8vo. 1779, p. 57.

(*h*) See Experimental Inquiries into the Lymphatic Syſtem by W. Hewſon, p. 182.

ampullulæ

ampullulæ filled with chyle, in a ſubject which died ſuddenly; that he applied the microſcope, and ſaw the abſorbent orifices of the lacteals on the ampullulæ, and ſhewed this appearance to the late Dr. W. Hunter and to Dr. John Jebb, who were likewiſe of opinion that they diſcerned them. I have alſo found the ampullulæ in the human ſubject, and have ſeveral preparations of them in my poſſeſſion; they anſwer the deſcription which Lieberkühn has given of them, as well as that of Mr. Cruikſhank. I have ſeen them repeatedly of late years, in every ſubject where the lacteals were found to contain chyle in the dead body; in all theſe, when I have examined the villoſe coat with attention, I have diſcovered the ampullulæ. I have ſeen them of different forms, moſt commonly bulbous, as repreſented by Lieberkühn (*i*), I have alſo ſeen a number of ampullulæ filled with chyle, ſometimes forming cluſters, as repreſented in Plate I. of this work fig. 3. while in other parts of the ſmall inteſtines, I have found them ſolitary, and projecting beyond the villi, as may be ſeen in ſeveral of the figures in Plate I. This anſwers exactly to the deſcription of the accurate Lieberkühn (*k*) *Lacte turgentem et exinde propendentem.* I have examined many of theſe preparations by putting them in water in a watch glaſs, or in glaſs tubes, and have applied the microſcope, viewing them at one time, as opake, at another as tranſparent objects.

When I have obſerved them in cluſters, it ſometimes appeared to me, that the orifices were conſpicuous in their extreme points, which Lieberkühn has called, ſpeaking of a ſingle ampullula, (*l*) *foraminula in apice.* When I examined the ſolitary ampullulæ, their orifices were not to be diſcerned, ſo that it was a matter of doubt with me, whether the appearance of orifices in the cluſtered lacteals, was not that of the interſtices between the different ampullulæ.

When theſe experiments were made, I was unacquainted with (*m*) Lieberkühn's method of ſearching for the ampullulæ, and uſed to waſh away

(*i*) Vide Differt. Lieb. ut antea Tab. I. Icon 2.
(*k*) Ibid. p. 3.
(*l*) Ibid. p. 13.
(*m*) Ibid. p. 5.

the

the mucus. My want of ſucceſs might therefore poſſibly ariſe from this circumſtance; and I have not ſince had an opportunity of meeting with a proper ſubject, to make the experiment in the manner recommended by that anatomiſt.

The ampullulæ with their orifices, are then to be conſidered, as the beginnings of the lacteal veſſels; as parts capable of being erected by having a greater quantity of blood derived to the veſſels of their coats, in conſequence of their being ſtimulated either by the chyle, or by the fluids ſubſervient to digeſtion; this occaſions, as we imagine, a derivation of blood to them, and cauſes their orifices to be kept rigidly open, and the chyle is thus drawn into them by capillary attraction.

The lacteal veſſel ariſing from the ampullula, I have frequently traced, from having found it loaded with chyle in ſome dead human ſubjects.

Theſe incipient branches of the lacteals ariſing from the ampullulæ are ſoon joined to thoſe, which are repreſented in Plate II. fig. 1. 2. 3. theſe lead on, and are continued into thoſe trunks which will admit of the inſertion of pipes, and may be injected with quickſilver, as they appear in Plate III. IV. and V.

Not having had a ſatisfactory view of the orifices of the ampullulæ, I have judged it neceſſary, in order to render this work as complete as poſſible, to give a figure of them, taken from Lieberkühn.

In the firſt plate of this work there are ſeven different figures repreſenting the ampullulæ, and there are no numbers affixed to the different objects, that the plate might not be disfigured: in order to ſupply this deficiency, it may be noticed that the objects are to be reckoned from the left to the right in horizontal lines, beginning with the upper row. In figure 1. ſeveral of theſe ampullulæ are repreſented of their natural ſize, upon the internal ſurface of the villoſe coat of a portion of inteſtinum duodenum of the human ſubject. In this as well as in the other figures repreſented in this plate, they were loaded with chyle, and projected beyond the villi; ſome of them were bulbous or veſiculated (*n*) *veſiculam*

(*n*) Vide Differt. Anat. Lieb. p. 4.

ovulo

ovulo haud abſimilem,) while others, were of a cylindrical form, a difference which depends upon their being more or leſs turgid with chyle; for in proportion as they are diſtended, they will approach to the elliptical or globular form. This is rendered evident by the circumſtance of the lacteal veſſels, in other parts of the inteſtines, aſſuming a cylindrical figure, when they contain a ſmall quantity of chyle, and by their becoming of a globular form, between each pair of valves, when much diſtended.

(*o*) In fig. 2. a portion of the lower part of the ileon is repreſented; one half of this portion of inteſtine is cut open to ſhew ſome ſolitary ampullulæ on its villoſe coat. Upon that portion of the inteſtine which is entire, a part of a lacteal trunk diſtended with chyle is ſeen; it is one of thoſe which run immediately under the peritoneal coat of the inteſtine, and which we are capable of injecting with quickſilver.

In fig. 3. in the middle of the object, a cluſter of ampullulæ is ſeen loaded with chyle; and ſeveral ſolitary ones, which were remarkably turgid and projected conſiderably beyond the villoſe ſurface, may be likewiſe diſcerned. The object conſiſts of a portion of human ileon inverted, and the drawing was made from the preparations ſuſpended by means of threads in glaſs bottles filled with proof malt ſpirits, ſo that theſe objects are repreſented rather larger than they are in nature, from their being magnified by the convexity of the bottles.

In fig. 4. two of the ſolitary ampullulæ are ſeen as they appeared when magnified by the opake microſcope.

In fig. 5. the ſame ampullulæ are exhibited of their natural ſize.

In fig. 6. a cluſter of ampullulæ is repreſented.

In fig. 7. the ſame is ſeen as it appeared when magnified; and in this, I thought, as well as the ingenious artiſt who made the drawing, that the orifices of the lacteals were conſpicuous; but as we could not obſerve them in the ſolitary ampullulæ, when viewed with the microſcope, we entertained the ſame doubt with reſpect to their appearance, as was before expreſſed in page 37, of this work.

(*o*) Diſſert. Anat. ut antea, p. 4.

The ſmall figure in Plate II. which is taken from Lieberkühn, repreſents two ampullulæ which are remarkably turgid with chyle; a minute branch of a lacteal is ſeen ariſing from each ampullula, and the orifice in the extremity of the ampullula is diſtinctly ſeen, being rendered conſpicuous in the figure, by the ſpeck of ſhadow on the point. Several other orifices are alſo viſible on the ſides of the ampullulæ, and which are repreſented by ſpecks of light. (*p*) Lieberkühn informs us that he injected arteries and veins upon the ampullulæ; he obſerves that the finer branches are ſpread over them; he ſaw the fluid injection paſs from thence into their cavities, (*q*) *apertis oſculis hiant;* and run out by the orifice at the extremity; (*r*) *exire per foramen in apice hujus patens.* He is likewiſe of opinion that theſe cavities are filled with a (*ſ*) cellular or ſpongy ſubſtance.

There is nothing more to be found in Lieberkühn reſpecting the ſtructure of the ampullulæ.

Let us now proceed to trace and deſcribe every thing that is remarkable in theſe veſſels from this origin to their terminations in the thoracic duct.

I have been fortunate enough to diſcover the lacteals much nearer to theſe beginnings than they have been hitherto deſcribed.

Many years ago, when a ſtudent at the Weſtminſter Hoſpital, I found, in perſons who had died with ulcers on the villoſe coat of the ſmall inteſtines, the lacteal trunks under the peritoneal coat, much more conſpicuous, than in other ſubjects; and I injected them as well as ſome meſenteric glands of the firſt order with quickſilver, at that period.

I imagined myſelf to have been the firſt perſon ſince the time of Nuck, who had injected the human lacteal veſſels, and was therefore much pleaſed with my ſucceſs; but I ſoon learned from ſome of my anatomical friends that the preſent Profeſſor Monro had injected them, when he was ſtudying at Berlin, with the late Profeſſor Meckel; and this prepa-

(*p*) Vide Lieberkühn, Diſſert. Anat. p. 9. §. 6.
(*q*) Ibid. p. 9. §. 6.
(*r*) Ibid. p. 12. § .7
(*ſ*) Ibid. p. 13. §. 8.

ration

ration is ſtill in his poſſeſſion. My late ingenious friend Mr. Hewſon likewiſe informed me, when I mentioned this circumſtance to him, that he had once filled them in the human ſubject. Accordingly, I met with a preparation of a human lacteal trunk injected from the inteſtine, to a gland of the firſt order, in Dr. Hunter's muſeum, when I went to reſide with him as an aſſiſtant in anatomy, after the death of Mr. Hewſon. Upon inquiry I found that this was the preparation which Mr. Hewſon had mentioned to me; and it was the only ſpecimen of the human lacteals injected, exiſting in England at that time. Mr. Hewſon ſeems to have conſidered it as a matter of ſome difficulty to make ſuch a preparation, ſince he ſays in his work on the lymphatic ſyſtem, (*t*) "I have injected them with mercury even in the human ſubject."

When I examined the diſeaſed inteſtinal canal before deſcribed, I obſerved the following very curious appearance in ſeveral different portions of the ſmall inteſtines, which had been ſlit open and ſuſpended in water, till the blood was ſoaked out of them. When the object was viewed as a tranſparent one, I ſaw great numbers of pellucid veſſels running in the longitudinal direction of the inteſtine, and ſince that time, I have repeatedly ſeen the ſame appearance, and am happy in the opportunity it hath given me, of tracing the lacteals, and demonſtrating them, from their beginnings, as deſcribed by Lieberkühn, to their larger trunks, and of inveſtigating the complete courſe of theſe veſſels. This could not have been done, without theſe preparations, for we cannot inject them ſo near their orifices.

As this appearance was extremely curious, and was found difficult of repreſentation, I employed ſeveral draughtſmen to delineate it. My learned friend Dr. Antonio Scarpa Profeſſor of Anatomy and Surgery at Pavia, who was at that time in London, was likewiſe ſo obliging as to make the drawing from which the third figure in Plate II. was engraved, and this is the moſt accurate of the three.

An anatomiſt to whom I ſhewed this appearance many years ago, was of opinion, that, it was produced by the interſtices of the longitudinal

(*t*) See Experimental Inquiries into the Lymphatic Syſtem, p. 32.

muſcular

muſcular fibres of the ſmall inteſtines; but if this were the fact, it would be in ſome degree evident in all ſubjects; and would be particularly viſible in the inteſtines of thoſe, in whom the muſcular coat is ſtrong; neither of which circumſtances occurs. Beſides, theſe veſſels do not run parallel to each other, as the longitudinal muſcular fibres of the ſmall inteſtines do; nor do the latter fibres communicate or run into one another as the former; the opacity of the muſcular fibres is likewiſe greater.

It is however needleſs to inſiſt any longer upon this circumſtance, ſince it is eſtabliſhed beyond a doubt, by the exiſtence of the valves, which may be plainly diſtinguiſhed in ſome parts of the preparation; and by my having injected many of the trunks, which I have ſeen communicating with theſe veſſels, nor ſhould I have thought it neceſſary, to argue ſo fully upon this matter, if the gentleman above mentioned, had not been of a contrary opinion.

The branches I have juſt deſcribed, communicate with the abſorbent trunks repreſented in Plate III. of this work, which are ſo large, that we are able to inſert ſteel-pipes into them, and to inject them with quick-ſilver, which appears to have been firſt effected by (*u*) Nuck; the firſt anatomiſt alſo, who has given a figure from nature of the human lacteals.

(*x*) Duvernoi has likewiſe given us a very tolerable figure of a few lacteal trunks of the firſt order, which he found loaded with the chyle.

There is in (*y*) Bidloo, as well as in (*z*) Heiſter, a Plate of them, in which there is nothing material; and in (*a*) Cheſelden one ſo extremely incorrect, that it certainly muſt have been drawn from imagination. There is alſo a Plate by Santorini, in which ſome of the human lacteals are figured, in that elegant work lately publiſhed in Italy, by Michael Girardi, Profeſſor of Anatomy at Parma; but in this Plate there is nothing worthy

(*u*) Vide Nuck Adenographia p. 31. fig. 9. Ludg. Batav. apud. Sam. Luchtmans 1722. in 12mo.
(*x*) Duvernoi. Comm. Acad. Petropol. Tom. I. p .269.
(*y*) Bidloo Tab. xxxix.
(*z*) Heiſter Compendium Anatomicum, Tab. II. fig. 8.
(*a*) Cheſelden's Anatomy Plate XXIII. fig. 1. 5th. Edition.

of

of attention reſpecting the lacteals; theſe with the Plate by Veſlingius, which was conſidered in a former part of this work, and Lieberkühn's which we have lately deſcribed, are the whole of the plates extant of the human lacteals; and of theſe there are none which are of any conſequence except thoſe of Nuck, Lieberkühn, and Duvernoi.

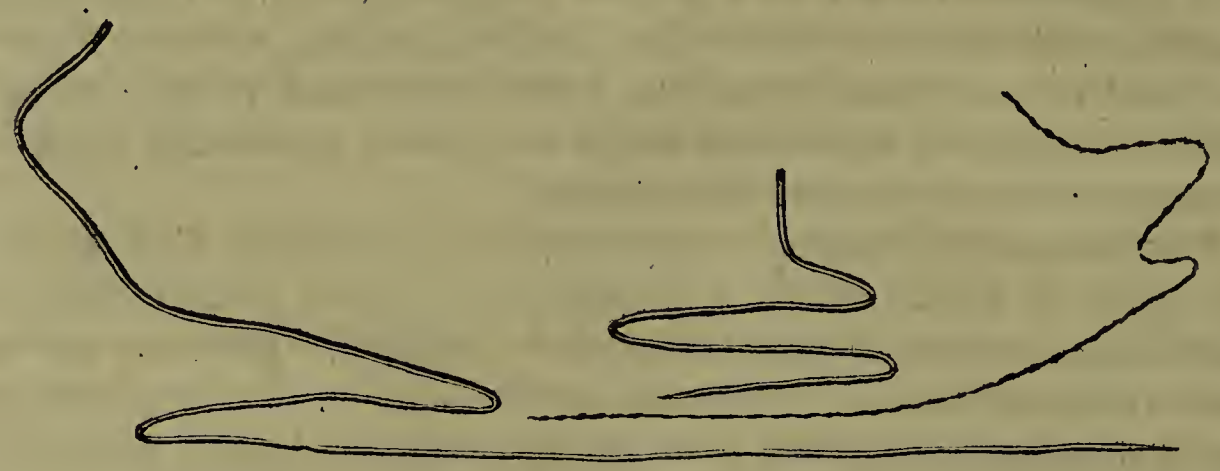
In the third Plate of this work, ten lacteal trunks are delineated, as they appeared in the freſh preparation after having been injected with quickſilver, and after the anterior layer of the peritoneum had been removed by diſſection, to ſhew their courſe through the meſentery, and their connection with the firſt order of lacteal or meſenteric glands. The preparation conſiſts of a portion of jejunum, with it's meſentery, from an adult human ſubject. The ſteel injecting pipe which is figured in Plate VI. was introduced at the lower extremities of theſe trunks, where the ligatures repreſented in the Plate were afterwards fixed, to prevent any part of the fluid from eſcaping.

We have in this figure, a ſatisfactory and intereſting view of the firſt order of lacteal veſſels, *vaſa lactea primi generis, ſeu vaſa lactea ingredientia;* the reader however is not to imagine, that there are no more trunks in this ſpace, than thoſe which are injected; on the contrary, he is to ſuppoſe, what indeed is the fact, that the lacteals are as numerous as the blood veſſels; which can be proved in the turtle, porpoiſe, and many fiſhes, and even in ſome quadrupeds. In this Plate, we obſerve the trunks upon the inteſtinal canal running ſuperficially and covered only with the peritoneum; we remark likewiſe, contrary to what we ſhould have ſuppoſed from analogy, that the trunks upon the ſmall inteſtines proceed in the longitudinal courſe of the canal, in a direction oppoſite to the courſe of the blood veſſels and nerves.

This remarkable courſe of the lacteals on the inteſtines I have ſeen in all the claſſes of animals, where the inteſtinal canal is connected to a meſentery, as in the human ſubject; and it is noticed in the turtle by our immortal Hewſon (*b*).

(*b*) See Experimental Inquiries into the Lymphatic Syſtem by W. Hewſon, p. 80.

As this peculiarity is found to exiſt ſo univerſally in nature, it muſt certainly anſwer ſome general purpoſe in the animal œconomy, and I am more ſtrongly inclined to this opinion, from obſerving that theſe veſſels are ſerpentine, as may be diſcerned in many parts of this figure and alſo in Plate V. This I have ſeen more obviouſly in ſome human lacteals, and have alſo noted the ſame appearance in injecting thoſe of the horſe and aſs. In the human ſubject I have always found, that the trunks of the lacteals on the inteſtine run on in the ſtraight line for a very conſiderable way. In order to make this appearance more evident to the reader I have demonſtrated it by the following lines (*c*).



The canal of theſe veſſels is conſiderably lengthened, by this arrangement; the chyle too is detained much longer in its paſſage to the thoracic duct, and the blood; and the fluid of courſe is more highly elaborated; for it is a well known fact, that all the animal fluids undergo conſiderable changes, in paſſing through their veſſels, and excretory ducts. The ſemen, for inſtance, is much altered in paſſing through that great length of ſeminal veſſels found in the body of the teſtis, the epididymis, and the vas deferens. We may therefore ſuppoſe that the chyle is alſo very materially changed in its progreſs, and comes nearer to the nature of

(*c*) The Object on the left ſide of the Page is taken from a lacteal on the ſmall inteſtine of the horſe, the middle one from the ſame inteſtine of the human ſubject, and the one on the right from the ſmall inteſtine of the aſs.

blood,

blood, to make which it is deſtined; and it is probable, that there exiſts, not only in the coats of theſe veſſels, but alſo in the lacteal glands, ſome power of producing this alteration, with the nature of which, we are yet unacquainted.

In this Plate we likewiſe obſerve, that the lacteal, where the trunk is riſing from the inteſtine to paſs on between the duplicature of the meſentery, forms an angle with that portion of it, which lies on the inteſtine; and this is one of the marks, by which we diſtinguiſh the lacteals.

The numerous valves found in every part of theſe veſſels, are conſpicuous, from the knotted, and in ſome places, the veſiculated appearance of them: their tranſparency, which depends upon the tenuity of their coats is likewiſe viſible in this figure. The lacteals are alſo ſeen dividing into branches before they paſs on to the glands; ſome trunks divide, on the meſentery near the inteſtine as may be ſeen in Plate IV, others run very cloſe to the gland or glands before they ramify; but all of them ſeparate into branches before they enter the glands; in this circumſtance they agree with the lymphatic veſſels.

Upon the upper part of this figure, four lacteal glands of the firſt order are ſeen, two of which are ſmall, the other two much larger. The cells which are found in all parts of the ſubſtance, both of theſe, and of the lymphatic glands, in all the different animals I have examined, are here injected. I have obſerved, that the magnitude of the cells of theſe glands, as well as of thoſe belonging to the lymphatics, differ, in proportion, to the ſize of the glands; being larger in the largeſt glands, as they are repreſented in the Plates. This circumſtance will be moſt diſtinctly ſeen in Plate III.

To complete the deſcription of this figure, it is only neceſſary to remark, that the veſſels kept in ſhadow, which form a kind of back-ground to the lacteals, are the arteries and veins, which were injected with red and blue in this preparation.

And here let me be permitted to return my grateful acknowlegements, to my learned friend Dr. Antonio Scarpa Profeſſor of Anatomy and Surgery in the Univerſity of Pavia, for his very great attention,

in

in making the drawing, from which this figure was engraved, as well as that of fig. 3. in Plate II. of this work, and for his ſolicitous care in the management and correction of the Plate. The original preparation from which this Plate was made, is in the poſſeſſion of Profeſſor Scarpa to to whom I preſented it.

We have now traced the veſſels from their orifices, through the meſentery, and to the firſt order of glands. The lacteals are to be conſidered, as performing the office of lymphatics to the inteſtines, as well as of lacteals, ſince the lymph in the interſtices of theſe parts is abſorbed by theſe veſſels, and muſt of courſe be mixed with the chyle. I have thought proper to mention this, becauſe ſome authors have ſpoken of lymphatic veſſels on the inteſtines, independent of the lacteals ; but theſe have been the offspring of their own imaginations.

In ſome ſubjects, the lacteals upon the inteſtines, will be found varicoſe, as in Tab. IV. where three lacteals upon the human jejunum are delineated from nature as they appeared when injected with quickſilver. The lacteals in this ſubject, a ſtrong corpulent male of about forty years of age, were as remarkably varicoſe, as I ever remember to have ſeen them ; but they loſe this ſtructure, ſoon after they emerge from the inteſtine. The middle lacteal in this Plate, is obſerved to break into four trunks, and forms a moſt beautiful appearance. Two other branches are ſeen paſſing into the lacteal trunk on the left ſide of the object ; theſe three lacteals after ramifying, paſs on to a gland on the meſentery, which they enter, and communicate with the cells, that are ſeen diſtended by the quickſilver with which they are injected. Three lacteals of the ſecond order, *vaſa lactea ſecundi generis, ſeu vaſa lactea egredientia*, are alſo obſerved, emerging from the gland. The preparation conſiſts of a portion of ileon, the lacteals are injected with quickſilver, and the part is dried, and repreſented ſemi-tranſparent, as it appeared to the artiſt, from being put into oil of turpentine.

Mr. (*d*) Hewſon is of opinion that Nuck has repreſented the abſorbent

(*d*) See Experimental Enquiries, Part II. by W. Hewſon, P. 18.

veſſels

veſſels too varicoſe, making them to reſemble chains of veſicles; but I have frequently ſeen this appearance in the human lacteals, as well as in many lymphatic veſſels of the human ſubject, and other animals, and this is exemplified in the Plate I have juſt deſcribed.

The *vaſa lactea primi generis*, or firſt order of lacteal veſſels, do not appear to have any conſiderable lateral communications with each other, ſince we are able to diſcover none by our injections; and the diviſion of the veſſel, into a number of branches, before it enters the gland or glands, ſeems to me to compenſate for the want of lateral communications. In the turtle and ſome fiſhes there are numerous lateral anaſtomoſes.

The lacteal or meſenteric glands, as I have noticed in a former part of this work contain, minute cells, (*e*) into theſe the firſt order of lacteals enter, and convey the chyle, and from them, the ſecond order, or *vaſa lactea egredientia*, ariſe. This kind of communication is evident in theſe glands, for if the lacteals be loaded with chyle, we always obſerve the cells of thoſe glands that join the diſtended lacteal veſſels, likewiſe loaded with chyle and appearing of a white colour. I have alſo found the cells of the lymphatic glands, diſtended in a ſimilar manner by the lymph.

Theſe facts are ſufficient to prove that the veſſels enter into, and paſs out of the glands; they are likewiſe ſupplied with a great number of blood veſſels and nerves.

We ſuppoſe a ſecretion to be performed by the minute branches of the arteries, which open into theſe cells, or that the chyle is altered in the cells, but we are ignorant of the nature both of this ſecretion and alteration.

Mr. (*f*) Hewſon is of opinion that the lacteals and lymphatic glands, as well as the thymus, ſecrete or form the central particles of the blood,

(*e*) See Page 45 of this Work.

(*f*) Experimental Enquiry into the Figure and Compoſition of the Red Particles of the Blood, &c. by W. Hewſon, in Quarto 1773.

or thoſe bodies which are found in the cavities of what he calls the red veſicles. That theſe glands do indeed contain particles ſimilar to thoſe mentioned firſt by Mr. Hewſon, and ſince deſcribed and figured by the late ingenious Mr. Falconar, (*g*) is evident to every anatomiſt, who will take the trouble of examining theſe parts with the microſcope, as directed by Mr. Falconar. But it remains yet to be determined, whether theſe particles be not originally formed in the chyle, while it is in the ſtomach, and in the inteſtinal canal, and conſequently before it is received, into the veſſels or glands.

The alterations produced in the chyle, by the action of the lacteals, and the meſenteric glands, muſt certainly be of the utmoſt conſequence, though we do not yet underſtand the nature of them.

Theſe glands appear to be of greater importance to young animals than to adults, and to man and quadrupeds, than to the other claſſes of animals. It is a remarkable circumſtance, that in the foetus and children, the lacteal and lymphatic glands are exceedingly numerous, but they diſappear, as we advance in age; ſo that in the adult human ſubject, there is not perhaps one tenth part of the number found in the fœtus. Theſe glands are of different ſizes, as repreſented, in Plate III. IV. V. Their circumferences are of a round or elliptic form, while their ſurfaces are ſomewhat flattened. In the compoſition of theſe glands, we can diſcover nothing more, than arteries, veins, abſorbent veſſels, nerves, and cellular membrane; and as the veſſels have muſcular fibres entering into their ſtructure, we are to conſider theſe muſcular fibres, as making a conſiderable portion of their ſubſtance.

The lacteal veſſels of the firſt order having ramifyed, ſpread their branches upon the ſurfaces of the firſt order of glands, or thoſe which are next to the inteſtines, and enter their cells: from hence, other trunks larger in ſize and leſs numerous than thoſe of the firſt order, ariſe, and theſe are continued into the next ſeries or order of glands, as they are

(*g*) Experimental Enquiries, Part III. by Magnus Falconar.

called

called. I muſt however acknowledge, that this diviſion of the veſſels and glands, into firſt, ſecond, and third order, has no juſt foundation in nature, and is of very little conſequence in anatomy or phyſiology; for we find that thoſe lacteals, which ariſe from the duodenum, only paſs through a ſmall number of glands, while thoſe which come from the lower portion of the ileon, take their courſe through ſeveral different glands, before they reach the thoracic duct.

The lacteal trunks continued from the firſt order of glands, paſs on to others, as may be ſeen in the fifth Plate of this work; and theſe are connected in a ſimilar manner, with other glands, in their paſſage to the receptalum chyli and thoracic duct.

In the fifth Plate of this work, upon a portion of human jejunum, from an adult female ſubject, ſeventeen lacteal veſſels are injected with quickſilver, by inſerting pipes into them, upon the inteſtine. They were remarkably large and varicoſe in this ſubject; and as the quickſilver was poured into the lymphatic injecting tube to fill theſe veſſels, it frequently ran out in a full ſtream by the jugular vein, which was opened.

This circumſtance rendered it evident, that the mercury had paſſed through the whole courſe of the lacteals and thoracic duct, and had penetrated even into the venous ſyſtem. It is, I believe, the only inſtance in which the thoracic duct has been injected from the lacteals on the inteſtines. In general the quickſilver which is puſhed into the trunks on the inteſtines, goes no further than to the veſſels, that enter into the firſt gland, with which the lacteal is connected, or to the cells of the gland. The *vaſa egredientia*, or veſſels emerging from the gland, are even injected from the firſt order of lacteals with difficulty; nor will the thoracic duct be eaſily injected from the ſecond order of theſe veſſels; at leaſt I have been very unſucceſsful, in the repeated attempts of this kind which I have made. This may be effected, however, from ſome of the larger trunks, on that portion of the meſentery correſponding with the upper part of the jejunum.

The

The lacteals which in this Plate form larger trunks, and are leſs numerous, terminate in the *receptaculum chyli*, or in the thoracic duct; for in many human ſubjects, this enlargement at the bottom of the thoracic duct, called (*h*) *receptaculum chyli*, into which the lacteals are inſerted, is not to be found.

In the laſt deſcribed ſubject, three lacteal trunks may be ſeen terminating in the upper part of the *receptaculum;* and it appears to me, that, in moſt human ſubjects, the trunks of the lacteal veſſels, are inſerted either into the upper part of the *receptaculum*, or into the thoracic duct a little above it.

In this Plate lacteal trunks were injected on both ſides of the inteſtines, and the ſeven lacteals in ſhadow, are thoſe which are repreſented as ariſing from the poſterior ſurface of the inteſtine. Some of the lacteals injected in this preparation are ſo varicoſe, that they reſemble the links of a chain; they divide before they enter the glands, and ſome of the firſt order of lacteals, particularly a trunk, on the left of the figure, is ſeen to paſs by the firſt order of glands, and to be continued to the poſterior ſurface of a large gland which is the loweſt of the three larger glands above. At letter h, a collateral anaſtamoſing branch may be obſerved, forming a communication between the veſſels of the ſecond order, and the trunks which terminate in the thoracic duct. Theſe lateral anaſtomoſes are found in every part of the abſorbent ſyſtem, (*i*) and they are of the utmoſt importance in the animal œconomy; for ſhould the glands, with which theſe veſſels communicate below, be obſtructed, the anaſtamoſing branches, will ſtill convey the chyle or lymph to the veſſels above the obſtructed gland, and this is moſt undoubtedly the caſe, in the *tabes meſenterica.* The cells of the glands, in this affection, are filled with a curdlike ſubſtance, and ſometimes with calcareous earth; and in many ſubjects labouring under this complaint, I have found all the lacteal glands intirely obſtruct-

(*h*) The *Receptaculum Chyli* has been called *Ciſterna lumbaris ſeu veſicula Chyli*, by Haller; and lacteal Sac by the late Profeſſor Monro and others.

(*i*) See Experimental Enquiries by Magnus Falconar, Part III. Plate II.

ed

ed, ſo that when I injected the lacteals, I could not make a ſingle particle of the quickſilver paſs into the cells of the glands; but the veſſels above the glands, in this inſtance, were injected with the greateſt facility, from the veſſels below the ſame. This is a proof that the collateral branches were increaſed in ſize, which was indeed apparent; and that they had conveyed the chyle, to the thoracic duct, without its paſſing through the glands.

Since the alteration which the chyle undergoes in healthy ſubjects, cannot take place in theſe diſtempered habits, becauſe the cells of the glands are ſtuffed up, and the chyle is prevented from entering into them; may we not readily account for the ſubject becoming impoveriſhed thin and conſumptive in theſe caſes? We are likewiſe to ſuppoſe, that theſe collateral branches alone, are not ſufficient to convey the chyle to the thoracic duct, in ſuch quantities, as to nouriſh the body. Theſe anaſtamoſes however, as I have obſerved in a former part of this work, will account for the way, in which the chyle was conveyed, into the ſanguiferous ſyſtem, in that extraordinary caſe mentioned by Mr. Cheſton of Glouceſter, and which I have before quoted (*h*).

I have now traced theſe veſſels from their orifices to the *receptaculum chyli*, and thoracic duct, and conducted the chyle, into the venous ſyſtem.

The reader may poſſibly be ſurprized, that I have taken no notice of the lacteal veſſels belonging to the larger inteſtines of the human ſubject; but the reaſon is that we have not yet been able to diſcover them. We are however certain that there are numbers of them exiſting here, from the great quantity of lacteal glands found on the *meſocolon*, near the inteſtine: and from the fæces becoming more ſolid in the lower part of the *colon* and *inteſtinum rectum*, than in that portion of the *colon* which is near the *ileon*.

In the third page of this work I have advanced, that the human lacteals are never found diſtended by the fixed air generated from putrefaction.

(*h*) See Page 30 of this Work.

But I am now obliged to contradict this aſſertion; my ingenious aſſiſtant Mr. Trye having lately ſeen an inſtance to the contrary.

In many quadrupeds particularly in the horſe and aſs, we can inject the lacteals coming from the *cœcum* and *colon* with the greateſt facility.

Whether the lacteals, at the root of the meſentery communicate with the lymphatic veſſels, is a circumſtance, which remains yet to be aſcertained; but as theſe veſſels are exactly ſimilar in their ſtructure, and as ſuch a communication would be a great reſource, where the glands are totally obſtructed, as in the *tabes meſenterica*, or in caſe of an obſtruction in the trunk, there is reaſon to ſuppoſe its exiſtence, and in ſubjects affected with the *tabes meſenterica*, I believe it poſſible to puſh the quickſilver into the thoracic duct with greater facility, than in ſound bodies, for the reaſon before given.

It is alſo neceſſary to mention that my indefatigable predeceſſor the late Dr. Hunter obſerved in his lectures, that he once found a human ſubject, in which there were either no valves in the abſorbent ſyſtem, or that they gave way to inflation; for he ſays he was able to diſtend the veſſels with air, a conſiderable way below the thoracic duct, by blowing in a contrary direction to the courſe of the lymph and chyle. Unfortunately the Dr. did not inject this ſubject, and ſince that time we have never met with a ſimilar inſtance.

I have now brought the firſt part of this work to a concluſion, and mean to proceed as ſoon as poſſible to the publication of the remainder, for which moſt of the Plates are already engraved.

The FRENCH *and* GERMAN *edition of this part are in great forwardneſs and will ſoon be publiſhed.*

F I N I S.

ERRATA.

Page 4. in Note (*c*) for Differat. *read* Differta.
10. line 28. *for* tnbe, *read* tube.
13. l. 31. — veſſels, —— veſſel.
16. l. 13. *after* packthread, *add* the neck being.
17. l. 22. *for* thoſe of, *read* as.
17. l. 24. — ſuch tubes, —— in glaſstubes hermetically ſealed.
18. l. laſt after unexplored, *dele* ,
31. l. 5. *for* bone, *read* bones.
32. l. 15. — Lionet, —— *Lyonet*.
34. l. 12. — dilitantur, —— dilatantur.
34. l. 22. — ſpritu, —— ſpiritu.
30. l. 9. *note* (*o*) *ought to be placed in the line above, after the the word* diſtended,

EXPLANATION OF PLATE I.

The different objects on this, and the ſucceeding Plate have no numbers affixed, in order, to prevent their disfiguration; they are to be reckoned numerically in horizontal lines from the right to the left hand beginning from above.

Fig. 1. repreſents a portion of the inteſtine *duodenum* from the adult human ſubject, opened, to expoſe its villoſe coat, upon which ſeveral *ampullulæ* are ſeen loaded with chyle.

Fig. 2. a portion of *jejunum* ſuſpended by a part of the meſentery is repreſented, the inteſtine is opened to ſhew ſeveral ſolitary *ampullulæ;* upon that portion which is entire, a lacteal trunk is ſeen loaded with chyle immediately under the peritoneal coat.

Fig. 3. repreſents a portion of *ileon* inverted, upon which many ſolitary *ampullulæ* may be obſerved loaded with chyle; in the middle of the object, a cluſter of *ampullulæ* is delineated, which are likewiſe loaded with the chyle.

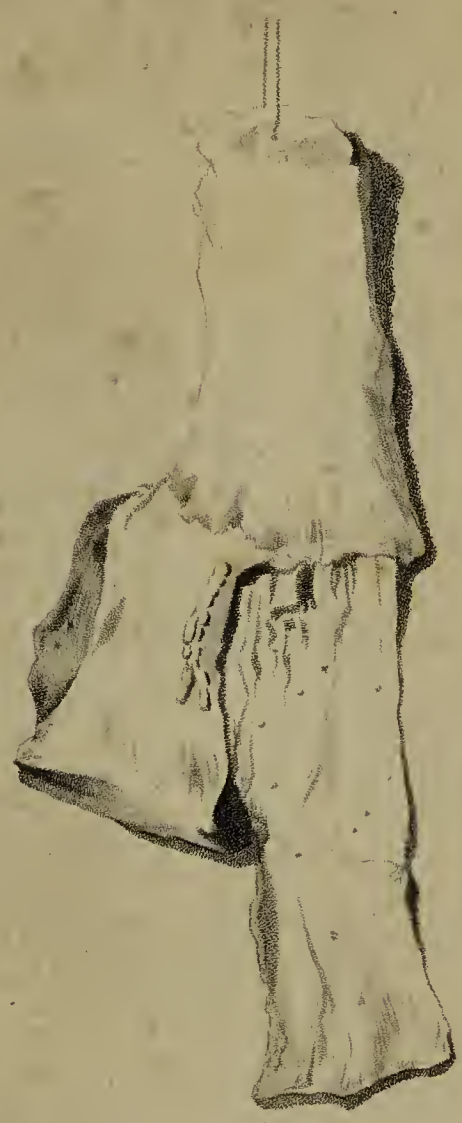
Fig. 4. two of the ſolitary *ampullulæ* are repreſented, as they appeared when magnified by the opake ſingle microſcope.

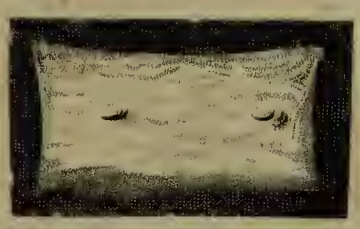
Fig. 5. repreſents the ſame *ampullulæ*, of their natural ſize.

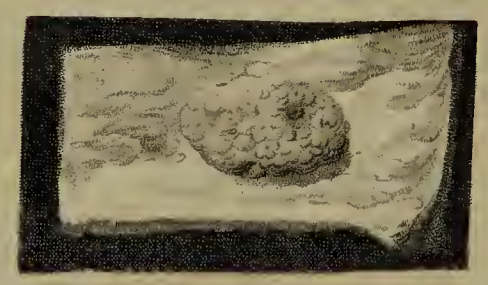
Fig. 6. is a delineation of a cluſter of *ampullulæ*.

Fig. 7. repreſents the ſame cluſter magnified, and in the magnified object we thought we ſaw the orifices of the *ampullulæ*, this appearance is demonſtrated, by the ſpecks of ſhadow on the cluſter.

TAB. I.





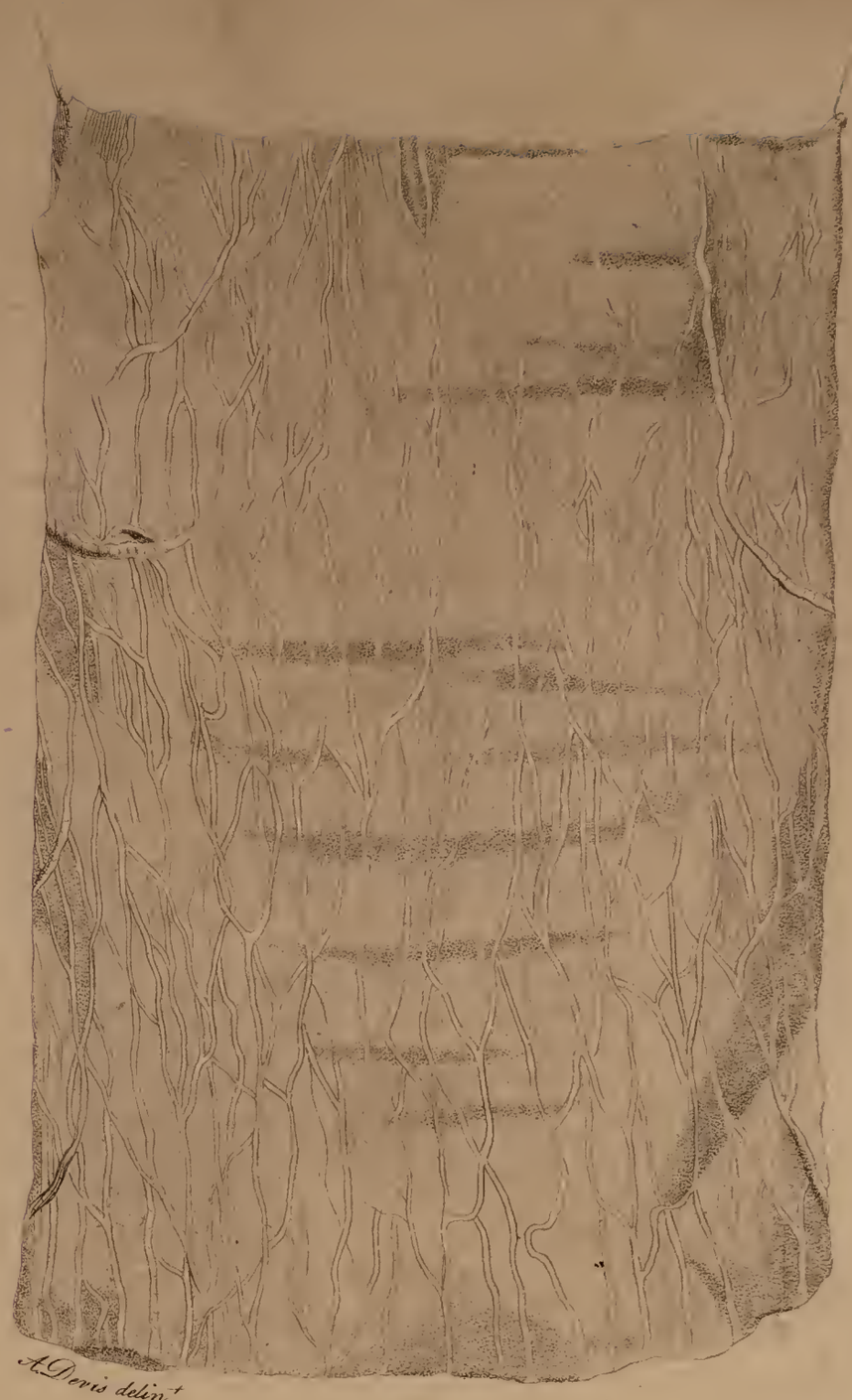


R. Livesay delin. Published by I. Sheldon, Jan.y 1782. C. Knight sculp.

EXPLANATION OF PLATE II.

The ſmall object in Plate II. is taken from Lieberkühns firſt Plate publiſhed in his *Diſſertatio anatomica de Fabrica & Actione Villorum Inteſtinorum Hominis.* It repreſents two *ampullulæ* magnified, which are remarkably turgid with chyle; their orifices are diſtinctly ſeen, particularly the one which opens upon the extreme point of the *ampullula*, which laſt is rendered evident by the ſpeck of ſhadow on the point; ſeveral other orifices may be likewiſe obſerved, upon the ſides of the *ampullulæ*, and theſe are marked by ſpecks of light; the lacteal which ariſes from the *ampullula* is alſo ſeen in this object. The three larger figures in this Plate exhibit the appearance of the ſmaller trunks and many of the branches of the lacteals, which are ſituated immediately under the peritoneal coat of the inteſtine, the minute branches of theſe, are continued from the veſſels, which ariſe from the *ampullulæ*, and which are repreſented in the laſt deſcribed figure. Theſe preparations were taken from ſubjects who died with ulcerations, which were diſperſed on the villoſe coat of the ſmall inteſtines, and the coats of the lacteals are rendered more opake in ſuch ſubjects, from the inflammation of the blood veſſels of their coats, which inflammation was moſt probably effected by the ſtimulus of the matter abſorbed from the ulcers.

TAB. II.



A. Davis delin.t

Ant. Scarpa Anat. Prof. delen.

Sarah Stone delin.t

London, Published by I. Sheldon, Jan.y 1782.

C. Knight sculp.t

EXPLANATION OF PLATE III.

In this Plate ten lacteals of the firſt orders injected with quickſilver are repreſented. The anterior layer of peritoneum, is diſſected from the meſentery, to ſhew their courſe from the inteſtine, to the firſt order of glands; the trunks on the inteſtine and meſentery are ſerpentine, and on the inteſtine they run in the longitudinal direction of the canal; the numerous valves which are found in theſe veſſels produce the knotted appearance which is ſeen in the lacteals repreſented in this Plate. Theſe veſſels do not follow the courſe of the blood veſſels, but run on to the firſt order of lacteal glands, upon the ſurface of which they ſpread their branches, having previouſly divided, the finer ones enter the internal ſubſtance of the glands, and open into their cells; and this is repreſented in the upper part of the figure, theſe cells are loaded with the quickſilver; and in this preparation we may obſerve that the cells contained in the ſmaller glands were leſs than thoſe in the larger. The veſſels placed in ſhadow behind the lacteal veſſels, are the arteries and veins which were filled with red and blue injection. The preparation was made from a portion of the *inteſtinum jejunum* of an adult human ſubject.

N. B. The lacteal which runs acroſs and behind ſome of the lacteal veſſels, that are ſituated in the middle of this object, and which appears to enter a branch of the third lacteal trunk reckoning from left to right, did not enter this veſſel but ran behind, and afterwards entered a gland on the oppoſite ſide of the meſentery.

TAB. III.

Ant. Scarpa Anat. Prof. delin.

C. Knight sculpt.

London, Published by I. Sheldon, Jan.ʸ 1782

EXPLANATION OF PLATE IV.

This figure repreſents a portion of *jejunum* from an adult human ſubject, it was dried, and rendered ſemi-tranſparent by being immerſed in oil of turpentine.

In this Plate three lacteal veſſels injected with quickſilver are delineated; they were remarkably varicoſe upon the inteſtine, but they loſe this appearance ſoon after they quit it; the middle one breaks into four branches and forms a beautiful appearance, the lacteal on the left likewiſe divides, and enters the gland as well as the one before deſcribed, the lacteal on the right, joins one of the branches of the middle lacteal trunk; the cells of the gland are injected, and three of the egredient veſſels or lacteals of the ſecond order are ſeen emerging from it.

TAB. IV.

S. Stone delin.t

C. Knight sculp.t

London: Published by J. Sheldon, Jan.y 1782.

EXPLANATION OF PLATE V.

The preparation from which this Plate was engraved, conſiſted of a portion of *jejunum* with it's meſentery taken from an adult human ſubject.

A. The inteſtine *jejunum* with it's meſentery.

B. B. Part of the thoracic and the whole of the abdominal portion of the *aorta deſcendens.*

C. The *receptaculum chyli* or lacteal ſac, into which the three trunks of the lacteal veſſels marked *i* open.

D. The thoracic duct.

a. The cœliac artery. *b.* The ſuperior meſenteric artery.

c. c. The emulgent arteries. *d.* The inferior meſenteric artery.

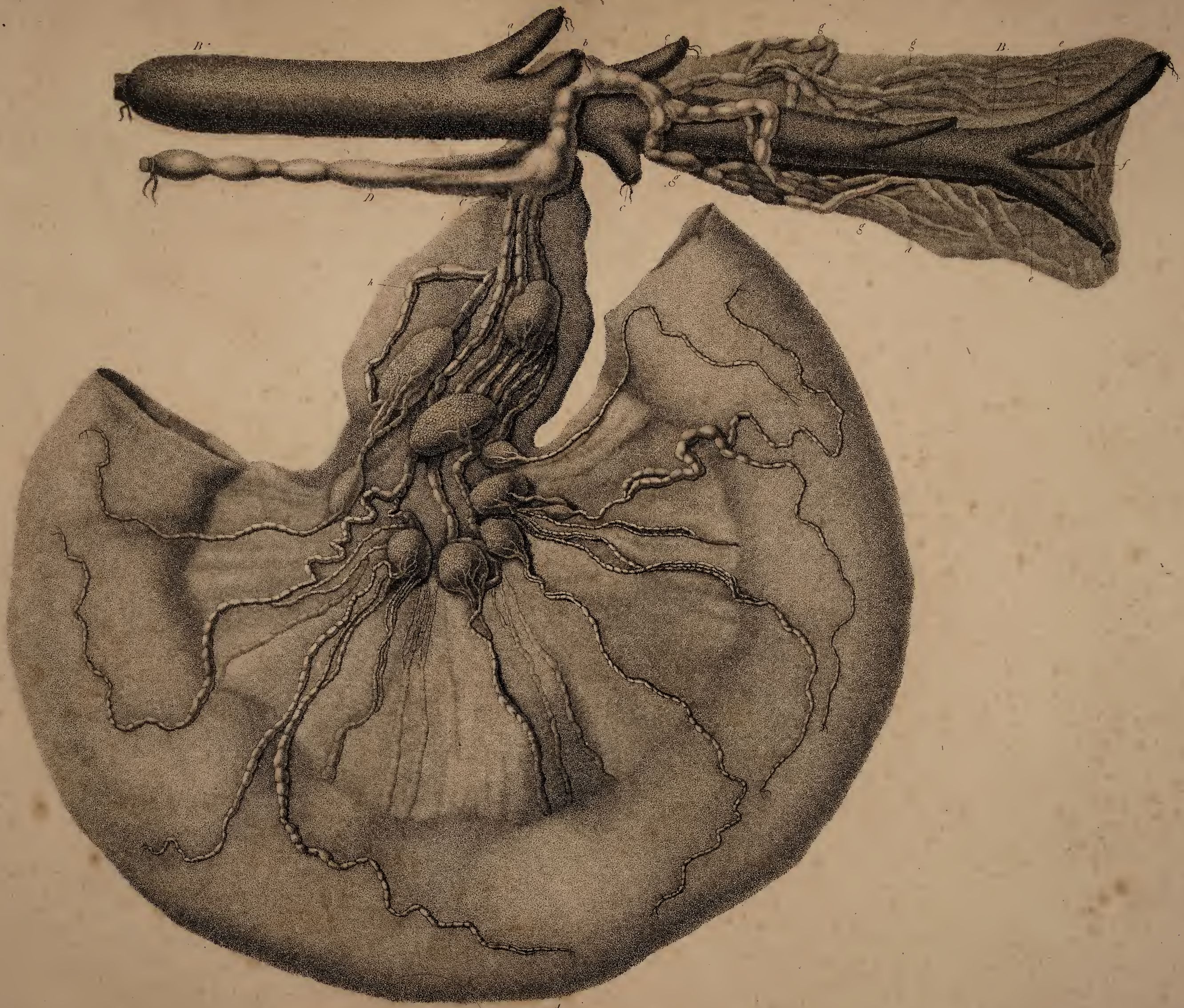
e. e. The iliac arteries. *f.* The ſacral artery.

g g g g. The trunks belonging to the lymphatic veſſels of many of the abdominal viſcera and inferior extremities: theſe with the trunks of the lacteals deſcribed above, compoſe the thoracic duct; the *receptaculum chyli* and the two trunks of theſe lymphatics form a vaſcular ring which encircles the aorta under the ſuperior meſenteric artery, theſe trunks unite and produce the firſt beginning of the thoracic duct *D.*

Upon this portion of inteſtine ſeventeen lacteals were injected with quickſilver, ſome of them were remarkably varicoſe and ſerpentine, and all the trunks run in the longitudinal direction upon the inteſtinal canal; nine lacteals are injected upon the anterior ſurface of the inteſtine, the others were injected upon the oppoſite ſurface of the ſame, and theſe may be diſtinguiſhed by their being kept in ſhadow, and from the veſſels being traced by the eye no further than the ſuperior edge of the inteſtine. The lacteals of the firſt order, paſs into the glands which are neareſt to the inteſtine, they emerge from the firſt order of glands, and paſs into others in their way to the thoracic duct; the lacteals in this preparation may be divided into the *vaſa lactea primi, ſecundi, tertii & quarti generis.* A lacteal of the firſt order, the ſecond trunk on the left of the object, eſcapes the firſt order of glands, and enters a gland of the ſecond order; it appears convoluted on the meſentery, but this depended upon that part of the meſentery being folded, upon which this portion of the lacteal was ſituated, it paſſed afterwards to the the poſterior ſurface of the gland, which is placed immediately above the firſt order of glands, and entered it's cells.

Four lacteals of the ſecond order are ſeen ariſing from the firſt order of glands; moſt of theſe are connected with the two glands which are ſituated next to them, and from theſe glands, other lacteal trunks of the third order ariſe, ſome of theſe paſs into a gland in their way to the thoracic duct, they afterwards unite and from three lacteal trunks, which paſs into the *receptaculum chyli;* at *h.* a lacteal is ſeen producing an anaſtamoſis between the lacteals of the ſecond order, and one of the trunks which are connected with the *receptaculum chyli.*

TAB. V.



R Livesay pinxit.

London Published by I. Sheldon Jan.y 1782

I. Newton sculpsit

EXPLANATION OF PLATE VI.

Fig 1. repreſents the lymphatic injecting tube of the proper ſize; it is made of glaſs; the ſuperior extremity of the tube is formed like the upper part of a funnel, for the convenience of pouring in the quickſilver, the other end has a collar of ſteel *a.* cemented to the tube, which contains a female ſcrew *b.* to receive the ſteel pipe,

Fig. 2. By means of a ſmall ſcrew *c.* Letter *d.* marks the godronned edge, which is made to fix the fingers to ſcrew or unſcrew the pipe. *e.* The pipe which is inſerted into the lymphatic veſſel.

Fig. 3. Is a poker made of iron wire to clean the cavity of the pipe.

Fig. 4. Is a curved pipe, which is ſometimes uſed in injecting lymphatic veſſels.

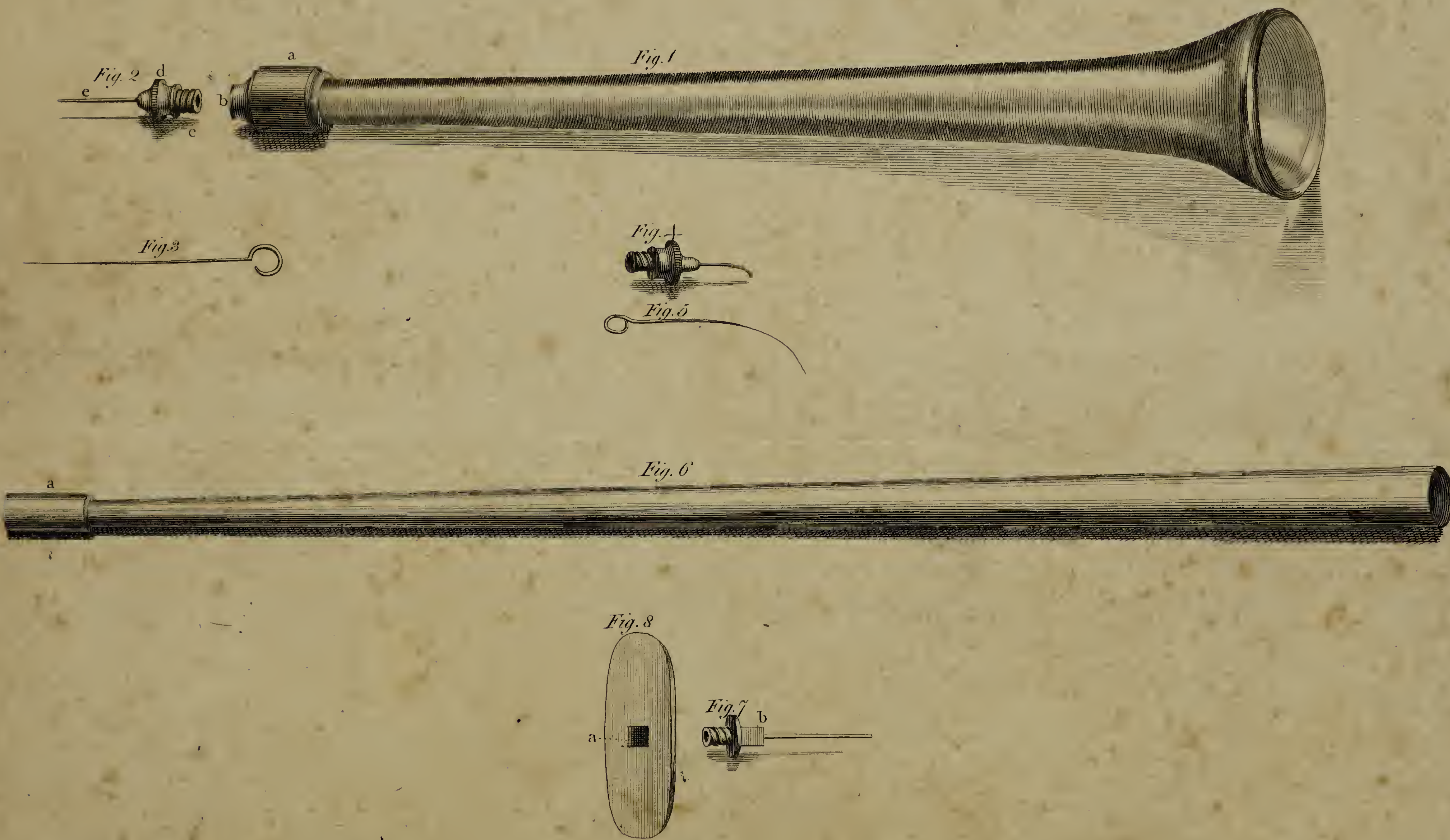
Fig. 5. Is a curved iron poker to clean the ſame.

Fig. 6. Repreſents the braſs injecting tube of the form it is uſually made by the workmen in London. *a.* Is a collar of the ſame metal, which contains a female ſcrew, as in the laſt deſcribed.—The upper end of the tube might be made like the glaſs one to advantage.

Fig. 7. Repreſents a ſteel pipe, ſimilar to the one firſt deſcribed, except inſtead of the godronned edge, the piece of iron into which the ſteel pipe is fixed, is made ſquare at *b.* to adapt a plate of iron or braſs,

Fig. 8. Which has a ſquare hole *a.* to receive the ſquare piece *b*; by the aſſiſtance of this Plate the pipe can be ſcrewed or unſcrewed with great facility.

TAB. VI.



Hills delin.

sculpsit